AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

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SCIENCE AND CROP GROWTH

SIR E. JOHN RUSSELL, D.Sc., F.R.S.

THE recent centenary at Rothamsted has reminded us that scientists have for many years been trying to find out something about the soil and growing plants and animals. They proceed by making the most accurate measurements possible and then by thinking about the results. The first to use this method for studying the growing plant was the Swiss botanist, de Saussure, who showed, 140 years ago, that plants build up most of their substance—all the organic matter—from air and water but take their mineral matter from the soil. It was a very fine piece of work but was purely a laboratory investigation. Nearly forty years passed before anyone realized that it had anything to do with farming.

Evolution of Artificial Fertilizers

It was Liebig, the famous German chemist, who first saw the connexion. Farmers and many scientists at that time believed that plants fed on the organic matter of the soil and manure: accordingly, they valued manures on the basis of their organic matter content. But if de Saussure was right, their preconception was all wrong; if the plants obtained their organic matter from the air, there was no need of supplies from manure. So Liebig boldly announced that manures should be mineral, not organic: they must supply phosphates, potash, lime, soda and magnesia, but need not contain carbon or nitrogen. This was a really brilliant generalization, the more so as it was made without preliminary farm experiments. Lawes, already working along the same lines, had shown the value of phosphates and had made and used superphosphate. Soon he also demonstrated the advantage to some crops of using potash, but he differed from Liebig in regard to nitrogen. He knew from actual weighings that crops benefit

by the addition of sulphate of ammonia or nitrate of soda, and, of course, he fully recognized the value of farmyard manure. Lawes went further than Liebig: he started making these mineral plant foods on a large scale and so founded the modern artificial fertilizer industry.

Lawes and Gilbert working together at Rothamsted made scientific experiments to show the effects of artificial manures on crop growths, but they did not themselves apply their results to farm practice, nor did they publish any recipes for the manuring of farm crops. This was done by Augustus Voelcker, father of Dr. J. A. Voelcker, whom many people remember with affection and respect. Augustus Voelcker made experiments in many parts of England with different fertilizer mixtures, and so evolved some very useful practical recipes, which remained in use for many years.

Scientist and Technologist This is typical of what happens in science. One man makes the discovery but does not translate it to any practical use: later, others develop it, and finally someone comes along who makes the practical application. Rarely is the latter the man who made the discovery—the two types of men are completely different. The good scientist is not usually practical enough to make useful applications of his results; and the good practical man has rarely enough science to make important discoveries.

So far it has not been at all easy to ensure a speedy practical application of scientific discoveries, and, in consequence, books on agricultural science contain masses of material which seem to have little or no relation to practical problems. The scientist is (as he must be) always ahead of the technician, and the worst of it is that all the time modern science becomes more and more complex and less and less understandable outside its own specialized sphere. It is not the fault of the science man: it is simply the facts of Nature which cause the difficulty. Even the simplest thing in Nature is great and wonderful beyond our comprehension, and there is no end to the wonder. Sixty years ago many people would have said that we knew pretty well all about the feeding of plants: they needed nitrogen, potash, phosphates, lime, magnesia and a little iron, and that was all. But more careful work with more refined methods and much more delicate apparatus showed that many other elements are needed also, though only in very minute quantities. If they are not supplied the plant suffers. Some of the mysterious diseases of the past are now known to be caused by lack of these essential substances ("trace elements" as they are called), and results of great practical value are beginning to emerge by the application of this knowledge. But again the application was not made by the discoverer, and indeed many years had to elapse before it came at all.

There is always this time lag in every science. A distinguished engineer recently put it as high as fifty years in engineering. For agriculture it is perhaps more like twenty years, not because the agricultural technologists are better than the engineers but because agricultural science progresses more slowly than physics. The reduction of this time lag is one of the big problems for the future.

Increasing Complexity of Science The problem is made more difficult by the circumstance already mentioned that as science advances it becomes more complex; it has long passed beyond the comprehension of any one man; specialization has become essential, and the specialist rarely has much interest in other things, or sufficient knowledge to understand them if he had. So the need

has arisen for group or team organization, where a group of specialists is brought under the co-ordinating influence of a Director whom they trust, and each is invited to apply his branch of science to the problems in hand.

Forty years ago, if you went to an agricultural scientific institution, you would have found a chemist, a botanist, and perhaps an entomologist, and with a reasonable education there would have been no difficulty in understanding the work they were doing and the appliances they were using. But to-day, at Rothamsted (and I use this as an illustration because I know it best), there is a team of some fifty trained scientists, many of them highly specialized. No one, however well educated, could go through the place and honestly say that he had fully understood everything that is going on; indeed, a small-minded man would go away and say it was wasted effort. Much of the work is on the extreme fringe of human knowledge. The work is difficult, and the worker has to be trusted and left entirely free to do it as best he can; it has never been done before, and no one can foresee the difficulties and pitfalls which he may come up against, nor whither a particular investigation may lead. There are many examples in the history of science of good work stopped because someone in authority failed to recognize its possibilities.

Ever Onward From time to time it is proposed that all further scientific work should cease, and that effort should be confined to making better use of the knowledge already accumulated. But that would never do: mankind moves either forward or backward: it cannot stand still. We must face the fact that science will continue to progress, and will become more and more complex and costly. Any attempt to canalize it or to keep it heading in some direction which seems to have practical possibilities and can be understood with least trouble, is bound to fail.

So it comes about that our scientific institutions contain a great amount of material that has never yet found its way into practice, and the better the staff has worked the richer is the store thus accumulated.

New Vistas It is impossible to forecast which discoveries will find application first, but some may not have long to wait. Soil chemistry, for example, is opening up considerable possibilities. The study of the plant nodule organism has led to inoculation of seed before sowing, and this has now become almost an invariable practice with lucerne; further developments seem likely to prove of value in making hill pastures.

A considerable number of root actions have been studied, and if we could only reproduce them ourselves, and find and use the chemical substances that bring them about, we might make another advance in crop production as big as that brought about by artificial fertilizers. It has been observed that when the seedling clover plant reaches the true leaf stage it excretes from its roots a substance that causes rapid multiplication of the bacteria necessary for its growth. These in turn excrete another substance which causes the root hairs to grow well and to curl, so producing kinks by which they can force a way in the surrounding soil. These excretions are presumably complex organic substances.

Other substances also formed by living organisms are harmful to bacteria. One of them penicillin, has now found its way into medical practice. Others are known in laboratories but have not yet been used: one found at Rothamsted is being studied.

Another root excretion, presumably different from any of these, may account for the remarkable decrease in the number of wireworms after a bean crop grown at Rothamsted. If the beans really had excreted some-

thing harmful to the wireworms it might be possible to synthesize it on a large scale and so open the way to the preparation of a group of good soil insecticides which at present we lack. The work on soil sterilization, started at Wye and at Rothamsted before the last war, was applied to glasshouse practice, but could never get on the farm because no suitable agent was found for field use. Some of these substances might supply the desired material.

Science and the Dust Bowl These possibilities may or may not eventuate. One other may be mentioned because it illustrates one of the great dangers of incompleteness in scientific work. The pioneer farmers of the prairies discovered that a fine mulch conserved soil moisture, and as drought was their worst enemy they developed the use of disc harrows. The scientific workers went into the question, and building up an explanation based on capillary action, they confirmed and emphasized the importance of making and keeping a mulch. Then came the catastrophe: after a time the soil lost its texture and fell down to a powder, and the "dust bowl" began.

This taught us a serious lesson; the scientific work should have started much further back, and the nature of the soil structure should have been investigated. Actually this was done later, and it showed that the value of the prairie soil lay largely in its crumb structure; that this crumb was produced by the action of grass and clover roots on the soil; and that constant cultivation without periodical breaks in sod caused these crumbs to fall to a dust which easily blows away. The recommendation should have been to rest the land periodically in sod, and not to mulch it continually.

It is easy to be wise after the event, but two valuable results emerge: short cuts in scientific work may lead to disaster; and if only we could learn more about this crumb-making by plant roots, we might hope to improve greatly both the productiveness and the permanence of our soils.

FENLAND FARMING

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Cambridge War Agricultural Executive Committee

A FENMAN of my acquaintance, after admiring a lovely sunshine and cloud effect over Ben Lomond, was overheard to remark, "Pretty, but not a patch on our fen sunsets". Yes, the fenman loves his fen. Even in this mechanical age, it is his willing hand behind the machine that has enabled the fens to contribute so handsomely to the country's food supply in the hour of need.

Fen soils differ widely in texture and depth. In colour they are as varied as the rats that followed the Pied Piper, and the problems connected with their management are more numerous and baffling than those on most other soils. It is true that the best fens normally crop very well, but Nature, even here, sometimes needs coaxing and the timely use of machine and hand labour before she will yield her bounty.

Certain features of fenland farming are reviewed in the following article with the threefold object of giving (a) immediate guidance on certain points

based on experience, (b) an indication of the divergence of opinion, even on elementary aspects of management, and (c) emphasis to the pressing need for intensive and controlled research as a guide to future development.

Drainage Most fens are below the level of high tide, even where they are situated from 50 to 100 miles from the sea. Drainage involves leading the high land water through them to the main rivers without allowing it to spill on the fens in its passage, and the collection and pumping of the low-level water in the fen ditches to these same rivers, by which it may be conducted to the sea.

The level at which the water should be maintained in the ditches for maximum production, the way in which the water moves in fen soils, the best size and shape of fields to allow of the most effective drainage or irrigation, and how these vary with the type and depth of fen, are matters of the greatest importance about which there is little reliable knowledge. Indeed, it is not uncommon to find two equally prominent and successful farmers living in the same fen holding widely different views as to the level at which the water should be maintained in the ditches during the active growing period in summer.

During winter comparatively empty ditches are an advantage, since they allow of normal maintenance work and promote quicker drying and earlier spring working of the soil. For the greater part of the growing season too, there appear to be advantages in a low water level; for the roots of the crops are then induced to spread and descend in their search for moisture, and are not restricted through waterlogging of the lower soil. At certain periods and for special crops there may be advantages in maintaining a higher water level, but with a great variety of crops, and a large number of occupiers in any one fen, it would be extremely difficult under present conditions to cater for individual requirements. Generally, from the point of view of uniform growth and resistance to disease, there are indications that the water level in the ditches should be maintained at a low level; but on this point there is need for much careful observation and experiment.

Loss of Top Soil Fen soils, whether deep or shallow, whether overlying clay, gravel and sand or chalk, are a wasting asset, in that there is a decrease in the thickness of the peat each year. This varies, not only with the type of soil, but also with the intensity of its cultivation. At times this wastage is accelerated by wind erosion, and though this could be reduced by such permanent improvements as claying, it seems that until some such practice can be revived there is a need for more immediate means to mitigate the loss.

The "strip" method of farming might alleviate the more serious consequences of gales in spring, particularly if certain strips were utilized for crops sown in autumn. At least, with this point in mind, it might prove possible in a number of cases not to leave bare in spring any very wide tract of open land.

Where possible, cultivations might be so planned that the soil is kept solid until near the time for the sowing or planting of special crops, e.g., sugar beet or potatoes. Where necessary, cleaning can be carried out in the autumn.

Another suggestion which may be possible, when the war is over, is to adopt a modified system of alternate husbandry, by which various

portions of the land in turn could be put down to a short-term ley for grazing. Apart from the effect of such a practice in tending to "hold" the soil, it would be one means of restricting the spread of such pests as potato or sugar-beet eelworm in areas where such troubles are causing anxiety.

Plant Foods Contrary to the somewhat popular belief, only certain fen soils are acid and in need of lime. This point is well worth attention, for the addition of lime to a light fen soil already well supplied may result in increasing the risk of the crop suffering from a deficiency of certain minor elements, e.g., manganese. Liming should be undertaken only after expert advice based on soil analysis.

Even fen soils like the "muck cart," and it is hoped that they will see more of it in the future than in the immediate past. There is little doubt that artificial fertilizers will give better responses where dung can be applied during each rotation.

The fens generally, but particularly the lighter soils that have been reclaimed during the war, are normally deficient in phosphates and potash, and numerous demonstrations and experiments have shown how the addition of well-balanced artificial fertilizers containing these elements can make all the difference between success and failure, particularly with such crops as potatoes, sugar beet and wheat.

It is considered by some that nitrogenous fertilizers are rarely required on fen soils. This may be true as regards the top dressing of cereals, but it is certain that growth and yield would suffer if such crops as sugar beet and potatoes were not given a dressing of nitrogenous fertilizer. Varying with conditions, one would advise the use of 2–3 cwt. per acre of sulphate of ammonia or its equivalent on these crops, provided that a suitable balance is maintained by the use of phosphates and potash.

In a few areas trouble sometimes arises through deficiency of a minor element such as manganese. The symptoms are most marked and the effects on yields most pronounced on sugar beet, potatoes and oats. The characteristic symptoms of manganese deficiency on these crops are a speckled yellowing of the leaves in sugar beet, a paling of the leaves of potatoes accompanied by small, brown, pin head spots and a stunting and greying of the leaf in oats.

There are a number of conditions which may show similar symptoms not connected with manganese deficiency, and it is desirable therefore that any farmer who believes that his crops may be suffering from this trouble should get in touch with his War Agricultural Executive Committee and obtain expert advice. There is a reasonable prospect that an application either of a manganese salt with the artificial fertilizer or the spraying of a manganese salt in solution on the growing crop may markedly reduce the severity of attack.

Important Crops Though a considerable range of valuable crops is grown in the fens, attention here is directed to three, occupying very considerable areas and now placed high in the priority list. Of the cereals, wheat is the most important. The desirable qualities of a wheat variety for fen conditions are: a high yield on a short to medium and stiff straw, early maturity and a high degree of resistance to such diseases as Mildew and Rust; locally, the varieties Yeoman and Holdfast do well. There is a number of other varieties, some quite new, about which there is as yet little reliable information as to performance. Here,

again, there appears to be a need for further trials and careful observation. Happily, a decreasing acreage is now being sown to unnamed and unsuitable varieties.

Seed dressing before sowing, suitable manuring, time and rate of seeding and width between the drills, each is important. As fen soils are frequently deficient in phosphates, superphosphate at rates from 1 to 2 cwt. per acre (which is probably all that can be allowed at present) can usefully be sown with the seed in a combine drill. Probably under most conditions the middle to the latter part of November is the best time for sowing, as wheat sown much earlier is apt to become winter proud. On the better soils, at least, a somewhat wider spacing between the drill rows and a lighter seeding rate per acre appear desirable to establish a robust and vigorous plant. Should the crop become too forward in the spring it is desirable that the excessive flag should be destroyed by a sulphuric acid spray or reduced by running or folding sheep over the crop. Such operations, however, should not normally be undertaken after the end of March.

Barley is not generally looked upon as a fenland crop, but very satisfactory results have been obtained with the variety Kenia, which has short straw and ripens early.

Potatoes and sugar beet are both gross feeding plants which benefit by liberal manurial treatment and a reasonably long growing period. Planting or sowing should not be delayed too long once soil conditions are suitable. The maintenance of healthy vigorous haulms free from Blight is a matter not only of time of planting and preventive spraying, but of allowing the plants reasonable room for growth. For preference, the rows should run north and south.

Sugar beet, once established, grows vigorously in the fens. For this reason it is all the more necessary to single as great a proportion of the crop as possible at the four-leaf stage, an operation which has much greater effect on the ultimate crop than is generally realized. Choice of varieties of potatoes and sugar beet presents perhaps fewer problems than with other crops, provided that proved varieties are selected. Majestic and King Edward are predominant in potato varieties, and in sugar beet, especially for the earlier sowings, the dwarfed top types are generally to be preferred.

Pests and Diseases Two of the most serious pests are Potato and Sugar Beet Eelworm. The latter is now the subject of an Order, and though this may do much to restrict its spread, it is also necessary that each farmer should make the eelworm battle his individual concern. The spread of these two eelworms is due to a disregard of the sound principle of rotational farming, and this points very clearly to the main direction in which farmers can assist in their control.

The same remarks apply to the more easily seen mustard beetle. A sound rotation, clean farming and the burning of rubbish around dykes, etc., can play a part in its control, as distinct from the direct treatment of the growing crop.

Mildew in cereal crops, particularly in wheat, also presents an important problem. Some of the suggestions made earlier in this article may minimize this trouble, e.g., the control of the water level in the ditches and the restrictions to prevent wheat becoming winter proud.

Summary This brief survey has indicated something of the potentialities and also the problems of the wide low-lying belt which comprises the fenland. There is little doubt that many fens have

been exploited, though perhaps somewhat differently from the way in which the wheat belt of America has been impoverished. Possibly the eelworm scourge is a first warning. The useful length of life of the fens and the degree of their fertility may well rest on whether we accept that warning or, thinking only of the immediate present, risk catastrophe by ignoring it.

MOLE DRAINAGE

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WITH a few exceptions, any land which is free from large boulders in the subsoil or underlying rock can be mole drained. Some farmers claim that land with a broken subsoil, in which sand and gravel seams alternate with beds of clay, is unsuitable for mole draining. This type of subsoil is frequently found in boulder clay and in fields which have very little fall. Such land can be mole drained successfully, provided sufficient main drains are put in. These may be spaced 20, 40 or 60 yd. apart. according to the kind of subsoil.

Main Drains No hard-and-fast rule can be laid down in regard to plans for setting out main drains, but a few general rules are worth noting. In fields which have a good fall in one direction, the main drains should be planned to run along their lower ends parallel to the ditch, at a distance of about 14 yd. from the brow. These may be drawn further away than 14 yd., so as to pass through the centre of any low places near the line of the drain ; but they should not be less than 14 yd. from the ditch. With the steam engine cable draining sets, the main drains were never placed less than this distance from the ditch, because the drainers started at the low end of the field and proceeded about 14 yd. before drawing in to the full depth. The size of pipes for main drains should not be less than 2½ in. diameter, with an outlet for every 3 acres of the area to be drained.

If to be dug by hand, a deep furrow should first be drawn with a plough. This is done by turning two furrows away on each side of the line of the proposed drain, leaving room for a final deep furrow in the middle. Where there is an uneven fall, it is a good plan to level this plough furrow to one continuous fall by cutting down the high places in the furrow before starting to dig the drain. The short outlets should be sited at any low or flat places along the main, and run direct into the ditch. When this has been done the men can dig the top and bottom spits, to the full depth of their spades, from one end of the drain to the other. Plenty of outlets is a good rule, but where they have to be made through high headlands, and the ditches require deepening, labour can sometimes be saved by making the low end of the main the only outlet. If this is done, start at the outlet and lay 4-in. pipes for one-third of the length of the drain, then 3-in. pipes for the next one-third and finish the remaining one-third with 2½-in. pipes : these figures are approximate for about 7 acres of land. Where the fall is slight, larger pipes are required than where the fall is pronounced.

It is also as well to brick up all outlets, leaving a few narrow spaces between the bricks above the pipes. This precaution serves three purposes : (1) it will prevent the end of the drain caving into the ditch ; (2) it will make

them visible; (3) it will leave extra outlets for water in times of flood, especially where porous material has been put on top of the pipes. The average depth of main drains should not be less than 26 in. from the surface to the top of the pipes. Then if the moles are drawn 22 in. deep, it gives 4 in. fall into the mains from the moles. If there is too little fall the moles are liable to silt up quickly. Some farmers put thorns or brushwood on the top of the pipes; others use burnt earth. Shingle or sifted ashes can also be used for this purpose.

Alternatively, Mole Drains First Another plan is to put in the mole drains first, then dig the mains, placing brick rubble or stones over the pipes where the moles cross them. If the latter plan is followed it is advisable to have a main drawn by the mole drainer about 30 in. deep, as a temporary measure against damage from floods before the pipes of the permanent drains are laid. This will prevent the moles from caving in and silting up through waterlogging. Often it is advantageous to put in one or two main drains one-third and two-thirds respectively up a long sloping field, and set them out to cross the plough furrows at a rising angle. If there is a ditch on either side of the field these drains can be cut into them. If there are no ditches the best plan is to dig a main right along the lower side of the field, about 22 yd. from the border, and divert it to any low places that may exist at the top of the field. Any cross mains can then be joined up with this drain.

The writer knows of one instance in which a field on a hill was moled before the main drains were laid. It never became necessary to put them in, because the bottom of the field had a gravel subsoil, and the moles drained into it without flooding the surface. This is an exceptional case and a practice which cannot often be followed.

Many of the stiff clay and heavy land farms until recently under grass were pipe drained 50 to 80 years ago. If such fields become wet it is often due, not to the clogging of the insides of the pipes, but to the fact that the clay in the course of years has settled around them so tightly that it prevents the water getting into them. In such cases, first ascertain the depth and direction of the old drains; then mole drain over them to within 2 in. of the old pipes. So treated, sluggish pipe drains can often be made to work quite well and the expense of putting in new mains avoided.

When the Work Should be Done Spring is a good time to do mole draining, although some heavy land farmers believe that mole draining carried out in the autumn, when the soil and subsoil are very hard and dry, is the most effective. They say that the water will subsequently get into the moles more readily, because large cracks are made in the hard land in every direction. The writer has had mole draining done over growing wheat in May without causing much harm. Also very little damage results to clover layers if the work is undertaken in dry weather early in the spring. When mole draining over crops is completed the seams left by the drainer should be rolled directly afterwards (*a*) to prevent dust and loose earth from getting into the moles, and (*b*) to put down clods and stones which might hamper the mower.

Make a Plan The distance between mole drains may be anything from 3 to 6 yd., according to the nature of the soil. They will last many years, provided the main drains are well laid, sufficient in number, and correct in depth. When they finally begin to give out the field can be moled again.

In view of this a plan of all new drains should be made, including the direction of the moles. If pipes larger than 2½ in. diameter are used for mains, the outlets should be covered with wire-netting. The writer once saw a main drain which had to be taken up because it had become blocked by the remains of rabbits; the animals had probably been chased up the pipes by stoats and there killed.

By carefully planning the outlets of main drains, one can often avoid unnecessary ditching. Some ditches carry a lot of water in winter, which submerges the pipe outlets. Where these are likely to be covered with silt, a hole should be dug in the ditch below the pipe. Some farmers make it a rule to send a man round directly after harvest to clear all outlets of drains and trunk-ways below gateways. This is an excellent idea, because they can be cleared much easier then than in winter when the ditches are full of water. Old farm hands often remember how fields have been drained in the past, and in the absence of plans of drains (a likelihood on most farms), it pays to seek their advice when mole draining is contemplated.

Steam Sets One regrets the passing of the old steam sets; they have not yet been excelled for draining stiff clay lands. These old-fashioned steam mole drainers are very powerful; they always pull uphill and leave a much larger channel in the subsoil than most of the tractor drainers do to-day. In practice, this is most desirable, because moles drawn against the fall of the field leave the inside of the channel smooth in the direction of the fall and consequently they are less liable to silt up. On flat land this does not apply to the same extent.

It remains to be seen whether tractor mole draining will last as long as the work of the old steam outfits. The mole drainers made to go with them will cut through roots as big as a man's arm, seemingly without effort. Coal is likely to be difficult to obtain, but if plenty of dry hardwood logs are available, they can be used to eke out the coal.

Mechanical Laying of Main Drains Mr. Bloomfield, Agricultural Engineer, of Debenham, Suffolk, has invented an attachment to fit the Fowler steam mole drainer. With this the pipes of main drains can be laid mechanically. Farmers who have seen it working have been much impressed by its simplicity and efficiency. I attended a demonstration of this contrivance at work laying pipe mains on Suffolk boulder clay. The principle of its construction is that steel plates are fixed on each side of the share of the drainer in such a way as to leave room for pipes in between. As the drainer proceeds a wide cleft is made in the soil. The drain pipes are directed down into this cleft by means of a steel tube which curves backwards. Men riding on the machine place the pipes end to end in the top of the tube, whence they are carried down into the drain by their own weight. The steel plates hold open the cleft in the earth long enough to enable the pipes to settle down flat, and they appeared to be as well laid as those put in by hand. The speed at which pipes can be laid by this machine varies from 400 to 800 per hour, according to their size. Mr. Bloomfield tells me that recently, in Norfolk, his outfit laid 15,000 2½-in. pipes in two days including moves, and that they can put in the outlets direct into the ditch by doing a little digging to let the machine in.

Waste material, such as screened ashes, could alternatively be poured into the cleft forced open by the drainer, so that they cover the pipes to a depth of 4 in. or to the top of the drain as desired. Thus it may soon

be possible to lay mechanically field drains which will last for 100 years or more and so enable farms which are still ploughed in narrow stetches to be cultivated on the flat—a great advantage in this machine age.

The Tools for the Job A set of draining tools is very handy for small jobs. Young men should be encouraged to learn the art of draining from those who have had practical experience. There is no more profitable work than draining a heavy land farm in the slack times during winter. The old horse-operated mole drainers, which worked with a windlass and wire rope, did quite good work. They made mole drains from 14 in. to 18 in. deep. Some of these are over 40 years old, yet a little water can still be seen trickling from them when they are cut open.

Modern requirements suggest the following desiderata for draining agricultural land: (1) surveyors to plan drains and take the levels; (2) a machine to make furrows to conform to those levels; (3) a drain-cutting and pipe-laying machine capable of doing the outlets as well; (4) a mole drainer to follow up and make moles over the mains when the latter have been laid; and (5) transport and labour to keep the machines supplied with pipes, fuel, etc. It should thus be possible to completely drain from 15 to 20 acres a day and serve both large and small farmers.

THE BIOLOGY AND CONTROL OF THE CARROT FLY

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THE Carrot Fly, *Psila rosae*, Fab., is widespread in Great Britain, and frequently causes serious damage to carrot crops in both farm and garden. In some districts it also causes much damage to celery, especially in the early stages of its growth. It also attacks parsnips and parsley; hemlock (*Conium maculatum*) is also a host.

Damage It is, however, as an enemy of carrots that the fly is chiefly important. The damage is caused by the larvae ("maggots") which bore into and feed upon the roots, causing them to become brown or "rusty". Seedling carrots are readily killed and a considerable thinning or gapping of the rows may result. Damage during later growth results in considerable stunting, and when the tap root is destroyed, very irregular, short, and often forked, roots develop ("chumps"). Attacked carrots can often be recognized by the wilting of the foliage, which may be reddish in colour. These features are most marked in dry weather, and probably result from serious interference with the water supply, following damage to the root system. Attack may occur at any stage of growth, including plants in the seed-leaf and second-year stages.

Life History and Description The carrot fly is a shiny black insect with yellow legs, brownish head, and two iridescent wings. The length is about one-third of an inch, and the wing expanse half an inch.

The eggs are white, elongated and very small (about one-fiftieth of an inch long) and are laid singly or in small clusters near the carrots, usually in cracks in the soil or just beneath the soil surface. They hatch in about a week, and the very small almost colourless maggots feed on the small tap-root and side roots of the carrot. Later they burrow into the carrot itself, and may pass from root to root. When fully fed, the maggots, then yellowish white, and about one-third of an inch long, leave the carrots and pupate in the soil. The pupa or chrysalis which follows is yellowish-brown in colour, and from this emerges the adult fly.

There are two generations of flies in a year. The first begins in late April or early May, and flies are most common in the latter half of May and early June. This generation emerges from land which grew carrots in the previous year, and spreads to carrot fields in the neighbourhood, laying eggs on early and main crops. Carrots sown in March and early April will therefore be subject to attack by the whole of the first generation. Those sown about mid-May and reaching a susceptible stage about three weeks later will be liable to attack from the latter part only of the first generation. The first generation attack on June-sown carrots will be very slight, as only a few first generation flies are about when these carrots appear. Generally, the later carrots are sown the more lightly will they be attacked by the first generation.

The second generation of flies appears first on early-sown carrots about the end of July. From mid-May sowings, flies can first be expected about mid-August, whilst mid-June sowings will produce very few second generation flies. This shows that the degree of first generation attack will largely determine the numbers of second generation flies appearing on a field. To summarize: the earlier carrots are sown, the heavier will be the first generation attack; the earlier will the second generation of flies appear on that crop; and the greater will be their numbers and the resulting damage.

Observations at Chatteris (Isle of Ely) have shown that the first generation continues to emerge from fen soil until well into August, whereas on the medium loam of Cambridge it ends abruptly about mid-June. This difference in duration of the first generation emergence has occurred in each of the three years over which observations have been made. At two other centres, in Norfolk and Suffolk (on light sandy loam), the first generation appears to emerge over a short period, as at Cambridge. This difference should mean that carrots sown in the latter half of May or later should be more heavily damaged in the Fen area than at any of the other three centres: this has been confirmed in practice.

There is some variation from year to year in the earliness of the first generation of flies. For 1941, 1942 and 1943, the periods of maximum emergence from fen soil were: May 30–June 5, May 15–21 and May 4–13 respectively. Corresponding differences were observed at Cambridge, except that the variations from year to year were slightly greater. Variation in date of emergence of the second generation has been dealt with above. The period of maximum emergence (about one month) appears to vary both with the year and the date of sowing the crop.

Cultural Methods of Control Recent work has emphasized the importance of cultural measures in controlling the carrot fly. Carrots grown on farms some distance from the old carrot-growing areas are not likely to suffer much injury from carrot fly

for the first few years. If, however, close carrot cropping is practised, a damaging fly population will rapidly be built up. This yearly increase can be checked either by growing carrots much less frequently in the rotation or by appropriate spraying (see below).

In districts where damage is usually prevalent, much relief can be obtained by not sowing until the end of May or later. Such sowings will largely escape damage by the first generation, and the second generation of flies, bred on the crop, will be correspondingly small. This comparative freedom from second generation attack will not occur if there are fields of early-sown carrots in the neighbourhood. These will act as a fertile source of second generation flies. Early carrots (sown in March and April) should always be grown as far away as possible from the maincrop and late carrots—say at opposite ends of the farm.

The building up of a high and damaging carrot fly population is greatly assisted either by allowing carrots to remain in the ground until the spring, or by ploughing in heavily damaged crops. The latter should be lifted in October or November and disposed of immediately. Recent work has shown that when carrots are lifted at this time about half of the total maggots present are removed with the carrots, and of the remainder in the soil, some 80 per cent. are immature and therefore doomed to starvation when the crop has been removed.

The carrot fly spends much of its time in shelter around the edges of the carrot fields, in dikes, hedges, nettle-beds, etc. Such places should be kept well trimmed and clear of bottom vegetation. As potatoes are particularly favoured for shelter, carrots should not be grown adjoining this crop. The importance of clamping is discussed on page 14.

Chemical Control The sheltering habit of the flies is the basis of a method of control recently worked out by the writers. The hedges, dike-sides and other shelter surrounding the carrot field are sprayed with a poison bait solution containing 0·8 per cent. sodium fluoride, and 2·5 per cent. molasses. The applications are made by a mobile power-operated machine delivering spray through coarse nozzles at high pressure (200–300 lb. per sq. in.). Some six applications, put on at 3–4 day intervals, are required for the first generation of flies, and about ten applications at similar intervals for the second generation. For the latter generation a strip of the carrot headland four yards wide is also sprayed, a boom carrying about ten nozzles being attached to the rear of the machine. This treatment has resulted in very high fly mortality: the estimated kill of flies on the four headlands of a four-acre field of maincrop carrots was 607,400 flies. Similar high kills have been obtained in other fields.*

The treatment has been tested experimentally over the last three years on fields of early and maincrop carrots in the Chatteris area. In all cases there was considerably less damage on the treated fields than on those untreated in the neighbourhood.

Comparing 8 treated fields (covering 107 acres) of maincrop carrots with 13 neighbouring untreated fields (covering 146 acres), the damage was on the average *two-and-a-half* times greater on the untreated fields, whilst the percentage unsaleability of the crop was *four* times greater on the untreated fields. These records were obtained in October and early November. Sampling later in the year showed even greater differences between treated and untreated fields.

* Further details of this treatment are given in a paper by Petherbridge, F. R. and Wright, D. W., *Annals of Appl. Biol*, **30**, 348.

In the case cited, as each of the treated fields was close to one or more untreated fields, the effectiveness of the treatment was somewhat reduced by the migration of flies from untreated to treated fields. This may be prevented, however, if in a given area all carrot fields which may serve as a source of flies are treated. Such a programme was carried out at South Acre, near Swaffham (Norfolk), where some 500 acres of early and maincrop carrots were treated in 1943. Here, very close carrot cropping had been practised for the past ten years, and had resulted in the building up of a high carrot fly population which caused considerable loss in 1942. The damage following treatment in 1943 showed a marked decrease as compared with the previous year, the average mid-field infestations for the two years being shown below.

Comparison of the Carrot Fly Infestation at Two Centres in Norfolk

Average mid-field attack in 1942 and 1943

Locality	Date of Sampling	Acres Sampled	Degree of Infestation				Total mines per 100 carrots
			Clean	Slight	Moderate	Heavy	
			per cent.	*per cent.*	*per cent.*	*per cent.*	
Swaffham							
Untreated	Nov. 13, 1942	182	78.8	17.8	3.4	0.0	36.6
Treated	Oct. 28, 1943	278	94.6	5.2	0.1	0.1	6.9
N.W. Norfolk							
Untreated	Oct. 20, 1942	159	91.8	7.4	0.8	0.0	12.2
Untreated	Oct. 26, 1943	156	91.4	8.0	0.3	0.3	11.9

The headland damage, which was more severe, showed a comparable decrease, the average unsaleability dropping from 19·8 per cent. in 1942 to 1·3 per cent. in 1943. This large decrease was not of a seasonal character, and did not occur in other areas sampled in East Anglia. In N.W. Norfolk (Fakenham area) carrots are taken only occasionally in the rotation, and the fields are widely scattered: this would appear to prevent the rapid building up of a damaging fly population.

Clamping The importance of clamping carrots has been brought out by a comparative study of the rate of deterioration of carrots in clamps and of those remaining over winter in the soil. This work has shown that if carrots are clamped in late October or early November very little further damage due to the maggots can be expected to occur during the following three or four months. If, however, the carrots are left in the soil over this period, the amount of maggot damage will at least double itself, with a much greater increase in the number of heavily damaged (unsaleable) roots. Moreover, frost damage, *which is heaviest on injured carrots*, is prevented by clamping. As stated earlier, heavily attacked crops should not be clamped, but disposed of at once. The clamping of late-sown carrots should be delayed until the carrots are mature; otherwise, the carrots will not keep sound within the clamps.

Treatment of Clamp Sites In the spring the soil under carrot clamps usually contains a high number of pupae. These should be destroyed by treating the clamp sites with a soil insecticide

in March or early April. Naphthalene at 4 oz. per sq. yd. or creosote-sawdust (equal parts by weight of creosote and sawdust well mixed) at 2 lb. per sq. yd. are both very effective. The insecticide is broadcast over the site, and lightly forked into the soil to a depth of three inches. The creosote-sawdust mixture, although the cheaper, usually prevents normal plant growth for a period of some five to six months after the application. With naphthalene, normal plant growth is possible after a few weeks.

A strong solution of formalin was tested in the field for destroying carrot fly pupae and was found ineffective.

The writers wish to thank the Agricultural Research Council for financing this investigation, Mr. A. S. Rickwood for providing facilities for experiment and observation, and Messrs. Pest Control Ltd. for carrying out the experimental treatments.

SHEEP

IN the fifteenth and sixteenth centuries, when wool production was particularly profitable, sheep flourished exceedingly. They subsisted mainly on grass. At the same time, the miscellaneous herbage of the stubbles and fallows also contributed to the sustenance of the flock. When the fallow was replaced by root and forage crops it was natural that a system should be devised under which the sheep consumed the crops where they grew. Thus arose the folding system, which played a large part in establishing the Down breeds as superlative mutton sheep and in maintaining soil fertility before the introduction of artificial fertilizers. By the twentieth century sheep had, for the most part, gone back to grass. Grass sheep farming, based on the production of fat lambs and young mutton, had enabled many farmers to keep going during the worst periods of agricultural depression. Sheep have always been, and are likely to continue, a distinctive feature of British farming. In relation to land area, their numbers are surpassed only in New Zealand.

Continuing the ***Farming To-day*** broadcasts on the Home Service, Mr. Mansfield, Director of the Cambridge University Farm, and several well-known authorities on sheep farming have attempted to reduce the broad problem to details which concern the individual farmer. It is hoped that the following summaries of the four discussions will be of interest to readers, especially those who may have missed the broadcasts.

I—The Arable Flock

W. S. Mansfield with J. C. Mann of the Norfolk Agricultural Station and Major T. K. Jeans of Broadchalke, Salisbury, Chairman of the Hampshire Down Sheep Breeders' Association . . . January 13, 1944

Opening the discussion, Mr. Mansfield regretted the passing of the shepherd and his hurdled flock. Some farmers declare that it is impossible to farm light land properly for any length of time without sheep. Others hold the opposite view. Which is right?

Major Jeans said that pedigree Down flocks are actually increasing, since progressive farmers are realizing that the folding flock is fundamental to good farming. He would not, however, go so far as to say that there *must* be sheep on light land; there were substitutes, such as the milking

bail. Folding or other practice depends on the character of the soil, and the lay-out and size of the farm. Much of his own land is chalk. Mr. Mann who farms light land in Norfolk—not chalk—has given up his folding flock because it was too expensive. East Anglian farmers had saved themselves during the depression in grain prices by turning over to sugar beet. Major Jeans considered that they were lucky to have such a cash crop, and thought that that was all the more reason for them to have stuck to sheep which could utilize the beet tops.

Question of Fertility At this point Mr. Mansfield brought the discussion down to three main points: (1) whether fertility can be maintained without sheep; (2) whether an arable flock can be made to pay; and (3) whether certain classes of arable land can be farmed properly without them. On the question of fertility Mr. Mann referred to the Sprowston trials, which have been in progress for 14 years, with sugar beet as the root crop in a 5-course rotation. The object was to compare the effects of sheeping beet tops, sheeping the equivalent value in swedes (tops having been carted off and replaced by swedes), ploughing the tops down, and applying artificials where beet tops had been carted off. All such treatments gave approximately the same yield of barley—two to three sacks more than the plot from which the tops had been taken and nothing put on. With "seeds" following barley and cut for hay, the results were again similar. There was little carry-over to wheat after "seeds" in the first rotation; but in the second, ploughing down and folding gave about one sack more per acre than the control.

But Major Jeans wondered why swedes were brought on when beet tops were there already, and he was further perplexed when told that the liveweight gains per week were 2·7 lb. on swedes and only 1·9 lb. on tops. (There was apparently some wastage of tops by treading.) It was claimed, however, that trials over 10 years showed that as regards fertility ploughing in was just as effective as folding. Major Jeans was not satisfied: the most important thing demonstrated, he said, is that neither mutton nor wool was produced, and both are primary necessities of life.

Sheep and Machinery This brought the discussion to the next point—whether mutton or wool pays. Many farmers had given up their flocks because they did not pay, even as scavengers of waste products. Major Jeans thought this was due to the fact that farmers, having lost their capital, had been unable to mechanize and modernize their businesses. He contended that there is not much direct profit in sheep at present prices, and it is almost true that a loss resulted if specific costing for sheep were taken. Some of the downland he is now farming had, in the past, dropped in rent to about 2s. 6d. an acre. To-day, by running his flock in conjunction with mechanized arable farming and a liberal use of artificial manures, he is able to grow crops that compare favourably with land formerly rented at £2 an acre.

In contrast with the Norfolk practice, where cross-bred lambs are produced from a ewe flock replenished annually from external sources, and where, therefore, flock depreciation is heavy, Major Jeans runs a pure-bred self-contained flock and every year sells a number of rams, as well as fat lambs. By breeding a few rams he enables the grass flockmasters to keep going with their cross-breeding.

Mr. Mansfield thought it is more difficult to keep land clean with sheep than without. Again Major Jeans could not agree. Machinery always

makes it possible to be well ahead with plans and work. Mr. Mann contended that his land is just as well farmed without sheep as with them, and that he is now producing more food for human consumption. Moreover, he is as greatly mechanized as other farmers on similar arable farms.

Major Jeans thought the general standard of mechanization is low. His own "outfit" includes a combine drill and a combine harvester. The latter "combines" well with sheep: a straw distributor fitted to the harvester spreads the straw evenly, and when the corn crop is undersown with trefoil and Italian ryegrass the young herbage grows up through the straw and provides some excellent sheep-feed. This can be folded up to Christmas, after which the trodden straw and young sod are ploughed back into the soil. Mr. Mansfield was impressed: he admitted that he found his sheep very valuable for folding such crops as ryegrass and trefoil (before fallowing) on his clay land in summer.

Doubt Cast on the Golden Hoof

Major Jeans was emphatic as to the value of treading light land. On the other hand, Mr. Mann prefers a really good roller. At Sprowston it had been found that treading affected appreciably the top half-inch but at 3 inches the effect had gone. Mr. Mansfield was also somewhat sceptical about the so-called benefits of treading. In a 4- or 5-course rotation folding means a lot of late ploughing and late sowing of barley, and consequently poor crops. Major Jeans avoids this contingency by taking two root crops before two straw crops, rather than barley after sheep. This plan, both Mr. Mansfield and Mr. Mann thought, restricts freedom of cropping and leaves farmers too much in the hands of their shepherds.

Asked what place grass plays in his system of farming, Major Jeans said it was one of the most important crops in his rotation. His leys are close folded. With a fold you always know where your sheep are and there is less likelihood of trouble from stomach worms. Mr. Mansfield could see the ram trade surviving and possibly the specialized production of early fat lambs, but for the rest, he was very doubtful about the future of folding. Major Jeans, however, stoutly upheld the practice and had the last word: "Successful farming," he said, "must overcome difficulties without discarding fundamental principles".

II—Sheep on Grassland and Leys

W. S. Mansfield with W. A. Stewart of the Northamptonshire Institute of Agriculture and Will Hogg of Earlston, Berwickshire . . . . January 27, 1944

The case for grassland sheep, said Mr. Mansfield, depends upon their being directly profitable, whereas with arable sheep some of the profit (if any) has to be found in the increased fertility of the folded land. Good grass is not an end in itself, but a means of producing meat or milk, and one of the best ways of doing this, in his opinion, is by sheep. Mr. Stewart commented that there is likely to be more grass than cows can utilize: new leys, in particular, can carry more sheep, and interest in sheep breeding is reviving. He instanced a farm of 340 acres, formerly all grass and now, except for 31 acres, all tillage, which is carrying double the number of stock it did before the war.

Supply of Breeding Stock The difficulty centres around a shortage of breeding ewes. The Scotch Half Bred (Border Leicester × Cheviot), the most popular sheep in the Midlands, is now costing double the pre-war price. To avoid the cost of replacement ewe lambs by a Suffolk ram are being retained for breeding ; an alternative is the Dorset Horn cross, or, possibly, Half Bred to Half Bred. At the same time, the hills must still be regarded as the chief source of supply.

Mr. Hogg said that with a return of confidence the numbers of both Half Bred and Greyface (Border Leicester × Blackface) would increase. The "pure" Half Bred is as prolific as the first cross, but he thought that after a few generations they tend to become less hardy. Customarily just a few first-cross ewe lambs are bought to maintain the original stock. Mr. Mansfield, while recognizing the advantage of being self-supporting, is attracted by the Suffolk × Half Bred cross ; the ewes are hardy and prolific and, in the end, readily saleable. Mr. Hogg regards this cross as the next best thing to the Half Bred—"next best" because he thinks they are not so hardy. Mr. Stewart's view was that they are hardy enough for the Midlands.

From the viewpoint of the supply of breeding ewes, Mr. Mansfield thought English buyers might well obtain Suffolk cross lambs from the North, many of which at present go to the butcher. They might be crossed with the Hampshire or Oxford ram.

Mr. Stewart indicated Wales as an additional source of breeding ewes. The Kerry Hill is a popular grass sheep in Northamptonshire, although generally crossed with a Down or Wiltshire Horn ram. For real quality, Mr. Mansfield mentioned the Welsh Mountain crossed with a Southdown, but Mr. Hogg thought that small lambs and quality would be definitely out of the picture for some time to come, and a lamb percentage of about 120 compared unfavourably with about 170 from the Half Bred. Mr. Stewart wanted a breed that could be bred pure on grass and folded from time to time as food supplies allowed ; the Dorset Horn comes as near as any breed to Midland requirements.

Mr. Mansfield thought that in the North, numbers of Suffolk flocks were kept on grass, but Mr. Hogg had not seen many of this sort, although they were to be found in Northumberland. As compared with the Border Cheviot, Mr. Hogg said the Sutherland or Caithness Cheviot is bigger and more docile, and probably the most suitable for breeding pure, although as a Scotsman it was not a policy he would advocate.

Folding On the question of folding, Mr. Hogg said he turned his flock on about 2 acres of roots at a time. His present root acreage was 50 for 150 cattle, 500 ewes, 200 ewe hoggs and 150 fattening hoggs. His ewes go out on to reserved hill land in January and February, and later come back to root feeding. It was generally agreed that some succulent food in winter is very desirable for the ewe flock, and in summing up Mr. Mansfield expressed the opinion that only light hill breeds can be kept on grass alone. In addition, a dual-purpose sheep seems to be required for grazing or folding, as the case may be.

Mixed Stock to Balance Grazing The next question was how best to manage the grazing ley. Mr. Hogg interpolated a warning about grazing with sheep alone. Balance in grazing is essential ; cattle must be provided for as well as sheep. Normal stocking

in the North is 2 ewes and double lambs to the acre, and in May, June and July, 1 bullock to the acre in addition. The lambs mostly go off as stores, but in the Border counties, Down-cross lambs were fed (before the war) to go off fat.

Mr. Stewart also favours mixed grazing, since, he contends, it produces more weight of meat per acre and safeguards the sheep from internal parasites. On this latter point Mr. Mansfield thought the Kent ewe is more resistant than other breeds, a claim which Mr. Hogg supported by reference to New Zealand, where stocking by the same breed of sheep is similarly dense.

All speakers agreed that, even with new leys, it is best to get as many lambs as possible away by midsummer; they rarely do so well afterwards, and the thinner stocking reacts favourably on the cattle. As the numbers of lambs increase, however, it will be necessary to organize marketing so that prices are not affected by glut.

"On-and-Off System" Mr. Mansfield then referred to the "on-and-off" system of grazing, so generally advocated. He doubted whether it was really practicable with sheep. Mr. Stewart thought that an occasional change is desirable when it can be arranged. In the North, Mr. Hogg said, the appropriate numbers of cattle and sheep are calculated as nearly as possible at the outset and left on indefinitely. Only if a field is particularly strong in June would sheep be taken off for a fortnight and put on some hard, old pasture. Mr. Mansfield was intrigued by this reference to old grass. He had always thought it right to retain a certain acreage of old grass and not to have all the grassland as young leys. There was general agreement on this point.

A reference to milk concluded the discussion. All considered that milk in the ewe is absolutely fundamental. It is no good having a prolific ewe unless she has the milk to nourish her lambs—"A point in favour of the Half Bred ewe," said Mr. Hogg. "Agreed," replied Mr. Stewart, "but the Dorset Horn is equally good in that respect."

III—Sheep on the Hill

W. S. Mansfield with Professor R. G. White of the University College of North Wales, Bangor, and M. G. Macdiarmid of Aberfeldy, Perthshire, President of the Blackface Sheep Breeders' Association . . . . February **10, 1944**

Mr. Mansfield first referred to the part played by hill sheep as the foundation of lowland grass flocks. He claimed that healthy and prosperous hill sheep farming is essential for the success of lowland and other flocks.

Factors in Sheep Production Indeed, in Professor White's view, the future sheep stocks of this country will consist almost entirely of hill breeds—such as, Blackface, Welsh Cheviot, and Swaledale and their crosses. Ram breeding arable flocks will provide rams for crossing with the hill ewes to give fat lambs in the lowland grass districts. Mr. Mansfield foresaw a considerable increase in demand for breeding ewes and wondered whether the hills could provide enough.

Mr. Macdiarmid thought not, as things are. Hill sheep farming had been going through a very lean time, owing to war-time prices of wool, lamb and mutton having been weighted against the smaller, high-quality mountain breeds. Isolation, and distance, transport, lack of education facilities, and the absence of centres of social life, all affected hill farming adversely. Besides, any further expansion of sheep breeding would have to await improvement of the grazings themselves. Professor White pointed out that the limiting factor is winter, not summer, grazing, and the great need is to improve the lower hills. One of the biggest expenses of the hill farmer is the wintering-away of ewe lambs. The ploughing up in the valleys has now made such wintering scarce and dear.

Carrying Capacity of the Hills

With improved uplands it might be possible to fatten some lambs on the hills, but Mr. Macdiarmid agreed that the ewe hoggs must come first. He thought that on the secondary type of hill land there is more of a future for wintering and finishing wether lambs direct off the hill when they are two or three years old.

In Professor White's view there is much to be said for the old system of running wethers on the hill until they are sent away fat. It gives a return from some of the poorest mountain land and makes for closer grazing; but it is unlikely to be an economic proposition. Mr. Macdiarmid thought it would be worth the country's while to make it economic, even although breeding stocks might have to be reduced correspondingly. Mr. Mansfield did not like the idea of reducing the breeding stock, but Mr. Macdiarmid countered by pointing out that the hill farmer is not in the business just to supply cheap ewes for the lowlands; he must have a market for his other products, including his secondary lambs, which at present are practically unsaleable. There might again be a demand for small lambs when land returns to grass, but even so, the wethers could go as stores from September to the end of November and relieve the usual glut of small sheep in August and September.

In any case, Professor White added, the carrying capacity of the hill is limited, and not all the ewes likely to be required can come direct off the hills.

How Far is Hill Land being Improved?

Mr. Mansfield inquired whether any attempt had so far been made to improve hill land to the level more or less of the land used for wintering-away. Professor White has ploughed up and reseeded a certain amount on the lower hills, making good deficiencies of lime and phosphate, but not yet enough to affect the number of sheep kept at home. In Perthshire, also, Mr. Macdiarmid said, there have been some experiments but the improved land has been used mainly to fatten off lambs, not for wintering. On the question of fencing, both Professor White and Mr. Macdiarmid insisted that improved land must be fenced off; otherwise sheep will concentrate on it at all seasons of the year, and contaminate and spoil it.

In reply to a question about the present stock-carrying capacity, Mr. Macdiarmid said it seemed to work out in Scotland at about an average of 5 acres to each ewe. Some Perthshire shepherds cover 5,000–6,000 acres. In Wales, Professor White said, there is a large area of unenclosed mountain which can be grazed in common. In addition, most farms have

some enclosed hill (ffridd) which is used only at tupping and lambing times. They would not, as in Scotland, run the sheep out on the hill winter and summer. They have to see that their own rams serve their own ewes.

Bracken Problems and Drainage Mr. Mansfield then referred to the hill cattle subsidy. Would it help to check deterioration of the grazings and the spread of bracken? Mr. Macdiarmid thought it would; but the keeping of a permanent stock of cattle is bound up with the supply of winter food and of labour. No doubt, trampling by cattle prevents the bracken from spreading, but the chief factor in the control of this pest was the human one. Formerly, when the Highlands were populated, bracken was constantly being cut.

In Professor White's part of the country the best control is effected by ploughing up in July. In Scotland, Mr. Macdiarmid thought there are too many stones for this method and that greater improvement could be effected by dealing with the heather, much of which has been left growing for 30 to 40 years. "All you want for that, surely, is a box of matches," said Mr. Mansfield; "Why don't you get on with the job?" Mr. Macdiarmid agreed that a box of matches might effect more improvement to the grazings than some of the more expensive schemes, but Professor White counselled caution. Heather burning had to be done rotationally and systematically, and it required an army of men to control the fire, or much harm might be done.

As regards drainage, it was said that more than a million acres of hill and in Scotland could be tackled with advantage. Formerly a lot of draining had been done. As for Wales, Professor White said little drainage has ever been done on the unenclosed land and, in the past 20 years, few drains have been opened on the lower enclosed hills. Perhaps drainage is less necessary in Wales: the slopes are steeper and the natural get-away more favourable than in Scotland.

Lambing Percentage The next question concerned lambing percentage. In Scotland it was said to be 80 to 85 per cent. In Wales the figure was not quite so high; it depends on the conditions. Ewes off the hill will give up to 150 per cent. on low grounds. Losses among ewes are 8 to 10 per cent.

Hill Breeds Still Hardy Both Professor White and Mr. Macdiarmid agreed that hill sheep had not deteriorated. The fact that rams might have been reared under soft conditions has not affected the hardihood of hill breeds. Mr. Mansfield thought it might not be too good if some of the rams are bred from ewes kept under very favourable conditions. Mr. Macdiarmid said it was not the practice to overfeed the ewes: if there was a point of criticism it was that ram breeders have concentrated rather more on mutton than on milking qualities. He did not favour a ram licensing scheme; owing to varying conditions it was necessary that a breeder should have a wide choice. Professor White, however, thought that the scheme was a step in the right direction.

IV—Maintaining Health in the Flock

W. S. Mansfield with W. Lyle Stewart, of King's College, Newcastle-on-Tyne, and J. F. H. Thomas of Broadchalke, Salisbury . . . . February 24, 1944

Sheep, said Mr. Mansfield, are subject to many diseases—some more prevalent in certain areas than in others. Once ill, sheep seem to make no effort to get well again; consequently, prevention is better than cure.

Mr. Stewart agreed that the problem is to keep sheep healthy, but thought that it is less a matter of one area being healthier than another than of suiting the breed or strain to the land. There might be a greater predisposition to disease in regions of high rainfall, owing to greater loss of minerals or deterioration of the herbage by overstocking with sheep at the expense of cattle. Such ground would then become infested with parasites. On clean ground sheep will thrive everywhere.

All agreed as to the need for balance between sheep and cattle in all circumstances. On the lowland pastures, said Mr. Stewart, cattle destroy millions of immature worms which would otherwise prey on the sheep. Cattle could with advantage also be taken on the hills—particularly on the rougher grazings. Fencing might, however, be needed to keep them there.

Unthriftiness Mr. Mansfield thought that more sheep are lost from unthriftiness than from disease, but in Mr. Stewart's view unthriftiness is just undetected disease. The best shepherds have an uncanny ability in recognizing immediately a sheep has ceased to thrive, but many people have a tendency to accept illness fatalistically. They may, for example, diagnose liver rot but completely ignore the underlying cause—bad drainage. Carbon tetrachloride is useful for control, but the origin of the trouble is in marshy land. Unthriftiness, in his opinion, is due mainly to parasites. Mr. Thomas agreed: "Low prices, permanent pastures and tired arable land took all the bloom off our flocks and added to our financial difficulties".

Worm Trouble In reply to Mr. Mansfield, Mr. Stewart advised dosing all purchased sheep as soon as they arrive home. Mr. Thomas, however, aims to produce lambs that do not need dosing, and would not advise the purchase of sheep about which nothing is known. By and large, however, Mr. Stewart would dose with phenothiazine (making sure that the correct quantity of 15 grammes or 3 tablets is given) regularly throughout the summer, beginning in June. It is a common experience that lambs cease to thrive after about midsummer, and this is due to parasites. The drug may not kill all the worms, but it does tend to reduce pasture contamination. Mr. Thomas thought routine dosing might sometimes be an unnecessary expense: infected sheep (usually showing dirty tails, pale eyelids and dry wool) should be treated, but when there is only one ewe to 2–3 acres, as in the South, trouble can generally be avoided. Daylight saving, he thought, had a good deal to do with worm troubles—"When the sun comes up the worm goes down." Formerly shepherds on the downs were able to keep their flocks off the grass until the dew had gone.

Mr. Mansfield then asked how long it would take to clear a field of worms. Mr. Stewart said the majority of the larvae are killed after ploughing, but even a new pasture is soon reinfested. This accords with Mr. Thomas's experience. He agreed with Mr. Mansfield that in folding sheep a run-back is dangerous. In the southern chalk counties, like Hampshire and Wiltshire, where close folding is practised, the sheep are kept up to the crop all the time. A mineral lick is a good thing for keeping down worm troubles.

Mr. Stewart contended that minerals are needed even more on the hills. In some areas there are diseases such as swayback and pining, for the control of which copper and cobalt have proved useful.

Tick-Borne Diseases and Worn-out Pastures "Well," said Mr. Mansfield, "if we agree that worms and mineral deficiency are the principal causes of unthriftiness in sheep generally, how do we explain the fact that the principal diseases in every district (according to the Scottish Hill Sheep Report) are tick-borne ? " Mr. Stewart explained that the control of ticks was not a simple matter, but is connected with poor worn-out pastures which harbour them. Ticks are unlikely to flourish in the South, and anyway north country sheep brought South can be dipped. Mr. Thomas thought that commonly dipping was not as thorough as it should be : it cleared sheep, not only of ticks, but also of lice keds and blowflies. The dip should be maintained at the proper strength throughout.

Foot Rot and Maggots Mr. Mansfield then referred to foot rot. This trouble does not worry Mr. Thomas who farms chalky land with plenty of flints. All purchased sheep are examined on arrival and put through the foot bath. Mr. Stewart mentioned that spent tractor oil with 4 per cent. oil of creosote added is more effective than copper sulphate, because the oil sticks to the hoofs.

As regards yet another pest—maggots—Mr. Mansfield mentioned that in the previous talk it had been stated that blowflies are now striking at higher altitudes than formerly. This, Mr. Stewart thought, might be due to the spread of bracken and failure to find dead sheep in the thick growth. Dirty wool (which is not uncommon with worm infestation) is also an attraction to flies, and here dipping is helpful as a preventive. In the South a run on sainfoin is a good way to keep sheep dry and clean.

Final Arbiter — Good Shepherding The discussion concluded with some reference to the value of herbs in pastures—burnet, chicory and the like—in contrast with the simple mixtures now generally recommended for new leys. All said and done, however, the importance of good shepherding cannot, in Mr. Thomas's opinion, be over-emphasized. "When you have a good shepherd, an interested flock-owner, and clean land, you only get bad luck when the weather goes wrong—and *that* you can't help."

TICK-BORNE DISEASES OF SHEEP

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THE sheep tick is commonly confused with the sheep ked, but in point of fact the two parasites differ considerably in shape and in their general habits of life. Ticks(Ixodes) have four pairs of legs and undergo a complicated life-cycle, of which only about three weeks is actually spent on the host animal. They readily distinguish themselves by their habit of attaching firmly by their mouth parts to the sheep's skin or the cow's udder, where they may remain stationary for periods up to ten or more days. Keds (Melophagus) also feed on blood, but are comparatively mobile and do not anchor themselves to one place. Unlike ticks, keds have never been convicted of transmitting animal diseases, and normally they are easily controlled by dipping.

Transmission of Disease to both Sheep and Cattle It is now established that the sheep tick transmits several important and fatal diseases of sheep and cattle. These are louping-ill (trembling) and tick-borne fever in sheep, and louping-ill and

redwater fever in cattle. In addition, investigations in the North have shown that another disease, quite distinct from either louping-ill or tick-borne fever, is responsible for a high annual mortality among lambs bred or ticky farms. The writer termed this disease "tick pyaemia," and as the name suggests, it is a generalized septic condition, characterized by the presence of multiple abscesses on the skin and throughout the internal organs and joints. This disease, which is very destructive, is not tick-borne in the strict sense of the term, but it arises as a sequel to tick bites, which commonly turn septic. All four diseases are of widespread occurrence in the tick-infested areas in the north of England, and a glance at the Balfour Report on Hill Sheep Farming in Scotland shows that they are by no means confined to these areas. Accurate information concerning the effects of the tick-borne diseases of cattle is still fragmentary, but deaths from louping-ill and redwater are not uncommon. Affected heifers are set back in condition, and failure to conceive is also attributed to tick-borne disease. In view of the present need to agist more cattle on upland grazings, this aspect of the problem is important, and will be given further study.

SEVERITY AMONG UNACCLIMATIZED STOCK

The tick-borne diseases are specially severe among unacclimatized sheep and lambs. It is not uncommon to lose one-half of an unacclimatized flock brought on to ticky land, and two to three times the normal number of sheep have been required to re-stock farms from which the native stock had been taken away. Even among native flocks the losses may be very high if for any reason the sheep are in poor condition, as happened during the severe winter two years ago. Tick-borne fever is characterized by the general malaise which accompanies fever, and there may be a high incidence of abortion among pregnant ewes. The writer saw a 60 per cent. abortion rate in unacclimatized experimental ewes newly transferred to ticky pastures during the active tick season. Newly purchased stock rams are liable to develop tick-borne fever, which causes them to be impotent during the mating season and predisposes them to pneumonia. Scores of engorging ticks cause much unthriftiness in hoggs and lambs, and when they are rendered tick-free by dipping or dusting they rest and feed better and therefore thrive more rapidly.

The importance of tick pyaemia as a cause of wastage on infected farms may be gauged from the following records dealing with the cause of death of 110 lambs which died in 15 days during May, 1937. The causes of death noted were as follows:

	Cases
Tick pyaemia alone	30
Pulpy kidney disease alone	18
Pyaemia and pulpy kidney disease	20
Lamb dysentery	5
Miscellaneous known causes	9
Suspected tick-borne fever	5
Indefinite	23
TOTAL	110

Thus pyaemia was encountered in 50 lambs and was apparently the cause of death of 30 lambs. It is notable that few lambs were found to have died from the better-known tick diseases, that is, louping-ill and tick-borne fever. Pyaemia tops the list. Further, this disease is often responsible for the lamb death-rate on tick-infested farms being monotonously prolonged throughout summer and autumn, and the net result is a diminished number of saleable lambs.

Louping-ill (Trembling) True louping-ill is a well-known disease of hill sheep, and occurs over wide areas of the Scottish and English uplands. It is caused by a minute germ, itself probably parasitic on the tick, and it is inoculated into the bloodstream when the infected tick attaches itself to the sheep for the purpose of feeding. This germ, or virus, on reaching the blood, multiplies there for several days, at the end of which it spreads to the central nervous system. There it attacks and destroys the delicate mechanism controlling balance and movement, ultimately producing paralysis and death.

The symptoms shown by affected sheep are entirely in keeping with the above events. Thus while the virus is active in the bloodstream, the temperature is high, and the animal dull and inclined to lie. As soon as the virus attacks the cells of the brain, however, there is a short period of excitability, during which the sheep twitches and trembles all over. This is a constant and sure sign of louping-ill. Gradually, as the brain cells are destroyed, the sheep staggers and is unable to maintain its balance. It now becomes recumbent, but the feet make violent paddling movements, sometimes turning the prostrate animal round in a circle. The mortality from louping-ill is very high, and recovered sheep are often left with a wry neck.

This may be regarded as the typical course of the disease, but as with all living things much variation occurs. Many sheep become infected and fail to show symptoms because the virus is overcome in the bloodstream by virus-neutralizing substances. Louping-ill attacks sheep, cattle and pigs, and there is a good deal of evidence showing that, in certain circumstances, it also attacks man. In man, however, it does not cause such a serious and fatal illness as its American cousin, the so-called "Rocky Mountain Spotted Fever". A fascinating account of this grim disease is given by De Kruif in his book *Men Against Death*.

Tick-borne Fever Most sheep and lambs grazing on tick-infested pastures show what was for many years regarded as a mild form of louping-ill. Recent investigations, however, have proved that this is actually a distinct and separate disease. It has been named "tick-borne fever," and resembles louping-ill only inasmuch as both maladies cause a degree of fever and are transmitted by ticks. Sheep of all ages are liable to be attacked, especially unacclimatized stock which is moved to ticky pastures during the spring and autumn. The immunity produced by one attack is not at all strong, so that repeated attacks are common, but the greatest damage from tick-borne fever occurs among young lambs which develop fever and lose condition. In all probability none of the lambs bred on infested pastures escapes the infection. For example, during May, a few years ago, the temperatures of 100 lambs were recorded daily for four weeks, and it is interesting to note that every one of these lambs showed, at one time or another, a high temperature phase during which the tick-borne fever bodies were present in the blood.

Sheep affected with tick-borne fever are dull and lose condition. If the disease is uncomplicated, it generally runs a non-fatal course with gradual recovery after two weeks, but there is undoubtedly much variation, and in some outbreaks the death-rate may reach 30 per cent. Frequently, tick-borne fever acts in concert with the virus of louping-ill, and when this occurs the mortality may be exceedingly high.

Tick Pyaemia There is truth in the adage that anyone can treat a disease, but few are capable of diagnosing it. The modern science of preventive medicine, so vital in ensuring that extra production for

which everyone is striving, rests to a very large extent upon the basis of exact diagnosis. It is worse than futile to use louping-ill vaccine or dysentery serum until it is known that these diseases are prevalent, and the history of louping-ill shows that much confusion has existed as to what was meant by this term. Fifty years ago, Sir John McFadyean found at least three separate diseases were called louping-ill, and more recently the writer showed that of 99 so-called cases, no less than 50 were affected with tick pyaemia. Results such as these indicate the great value which is attached to field investigations. Vaccination against true louping-ill can only be effective in flocks where there is a high incidence of this disease.

In a number of districts tick pyaemia has been found to be the biggest individual cause of lamb deaths. The causal organism is a germ which invades the blood and lymph streams via wounds produced by tick bites, whence it is conveyed throughout the body. The germ may locate in any organ and the result is multiple abscess formation. The onset of the disease is slow and it runs a chronic course, producing death only when some vital organ or function is impaired.

Redwater Fever Redwater occurs in cattle and is caused by a minute parasite of the red blood cells which is transmitted by the bite of the sheep tick. The red colouring matter is thus allowed to escape and its passage in the urine has given rise to the above descriptive name. The incidence of redwater in Britain has not been accurately mapped, but it is probably widespread. It is not known to cause such heavy losses as have been experienced in other countries.

Control of Tick-borne Diseases The eradication of sheep ticks from infested grazings is perhaps a legitimate long-term objective, although the immediate problem is not eradication, but how best to prevent or limit the losses ticks cause in sheep and cattle from diseases and under-productiveness. Some experience of the general problem of control suggests that success is most likely to result from "combined operations," that is, by (1) attacking ticks on the host; (2) attacking them on the ground, and (3) by devoting even more attention to the immunization of animals against the specific tick-borne diseases. Space does not permit of a detailed discussion of these various aspects of control, but results of practical value are already emerging. Needless to say, the problem is a complex one, impingeing on the fundamentals of tick ecology, hill land improvement and on the principles of sheep dipping.

A number of sheep dips are highly lethal to ticks, but the chosen acaricide must fulfil so many exacting requirements that it may be doubted whether the ideal substance has yet been discovered. For example, besides being an effective tick-killer, the dip must be well retained by the fleece in order to prevent re-infestation for a reasonable period, and it must be harmless to the sheep and also cheap and plentiful in supply. In this connexion it is of interest to note that dusting young lambs with derris powder is highly effective both as tick-killer and deterrent. It has also been used on adult sheep, and seemed to be more effective than dipping, but the dry dust is liable to cause blindness in ewes, and for this reason its use was discontinued. Fortunately young lambs can be dusted with safety.

In the course of its life-cycle, the sheep tick spends from 1½ to 4½ years on the ground, and relatively only a few days on the sheep or other host. Thus, it seems worthwhile searching for practical methods of ground control.

Destruction on the ground has many advantages, the most obvious of which is the fact that it aims at killing ticks before they can damage the sheep. Preliminary trials already point to the possibilities of tick reduction with relatively little labour, and attack on the ground may prove applicable to the better parts of a grazing.

Finally, we must consider specific immunization. Veterinary science has already perfected a number of valuable preventive and curative remedies against the tick-borne diseases. Louping-ill vaccine is now widely used and gives gratifying results, especially in adult sheep. Unfortunately it does not protect young lambs. Redwater fever in cattle responds to appropriate drug treatment, and some encouraging results have also been obtained in the treatment of tick-borne fever and pyaemia. The whole field of specific control of the tick-borne diseases is now ripe for further study, and its exploitation is certain to lead to an extension of the methods of prevention and cure.

Writing over 100 years ago, Youatt described the tick as a "formidable insect". Disregarding the slight terminological error, it can certainly be said that the tick is more formidable than even Youatt suspected. In the interim, however, much knowledge has been acquired about control measures, and this deserves the widest possible publicity.

WAR-TIME FARMING IN THE WEST RIDING

W. P. Richardson, O.B.E., F.L.A.S.

and

Ian Moore, M.Sc., Ph.D.

Yorkshire West Riding War Agricultural Executive Committee

FEW counties have so varied conditions of soil, climate and systems of farming as the West Riding of Yorkshire. Most types of soil are represented, including the deep, rich warp of the Goole area, the fertile sands of Selby, the quality-producing magnesian limestone, together with coal measures, millstone grit and mountain limestone.

Pre-War Picture In pre-war days the county could be divided roughly into three main farming regions. The eastern half, which includes the magnesian limestone, warp and sands, was largely arable. Here the four- or five-course rotation was in general vogue, with emphasis on potatoes, wheat and barley. Sugar beet, of course, had extended, largely replacing the root crops, which were folded by sheep. Indeed, there is little doubt that beet with its definite price and valuable by-products in the form of tops for folding and pulp for feeding, represented a sheet anchor.

By 1939 the depression had certainly left its mark. The heavier classes of land had tumbled down to grass, and poor out-lying farms had fallen into disrepute and disrepair. Ditches were overgrown, hedges neglected and much of the farming was conducted on ranching principles, which involve the least possible expenditure on labour, equipment and fertilizers. In the western half of the county, two clearly defined regions existed. North of a line from Leeds to Bradford was exclusively pastoral, covering the millstone grit and the mountain limestone formations. Here the

rearing of cattle and sheep was the primary object of farming, although latterly a number of men had gone in for milk production. South of the Leeds-Bradford line the area consists almost exclusively of millstone grit and coal measure soils, and here agriculture takes second place to industry. Steel, coal and the woollen industry dominate both land and people, and although the area includes a high percentage of arable land, agriculture must needs cope with innumerable difficulties which are inseparable from the location of industry. The inherent lack of lime in the soil is aggravated by industrial fumes. All crops in the district depreciate in value from the coating of soot deposited on them by the smoke of works and foundries, and the problem of trespass is always acute. To compensate for these drawbacks there is the undoubted advantage that the market for milk, potatoes, meat and vegetables is on the farm doorstep.

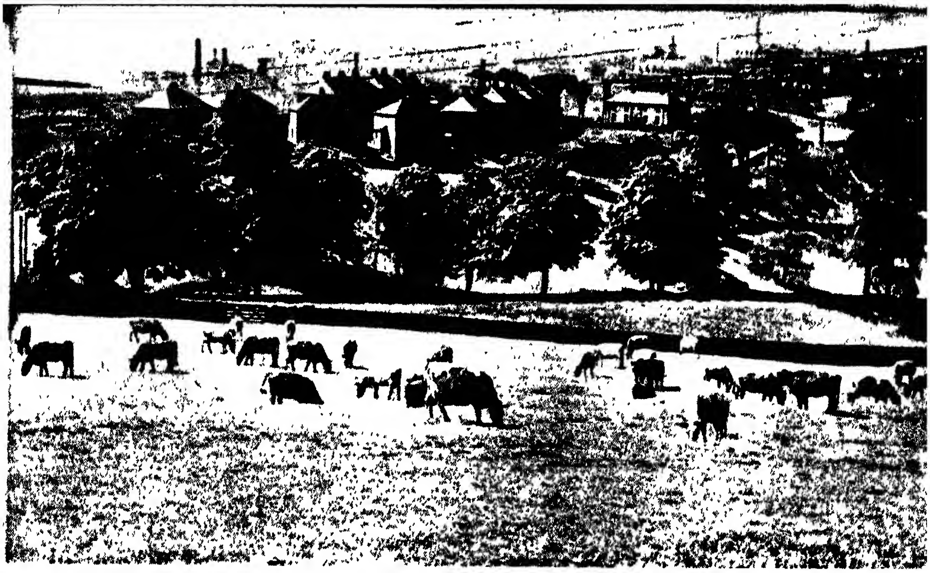
Regeneration That, roughly speaking, was the picture in 1939. Four years of intensive ploughing out and of supreme effort on the part of the farmers and farm workers has altered it completely. In the former arable districts the poor tumbled-down grass has been ploughed out for arable cropping. Much of the old worn-out arable land has been sown to recuperative leys, and a much greater intensification of farming has taken place. Drainage systems now function again. Where lack of drainage was the cause of trouble, new systems have been laid down. Ditches have been cleaned out, hedges relaid and everywhere there is an air of purposefulness—so that one can say that the farming is now good and the output from the land excellent. If anything, the intensification of cropping has in some places been excessive—in the Goole area, for instance, the problem of potato sickness is now arising. Continuous wheat-growing has, on a few farms, resulted in the spread of Take-all (*ophiobolus*), but on the whole crop rotations have been closely followed. As might be expected in a district of this type, fears are expressed of some loss of fertility, but as far as records indicate there are no grounds for concern where the land is in the hands of a capable farmer.

Increased Stocking on Reseeded Land Ley farming is the accepted principle in the area, with emphasis on the short ley. Flax provides a useful cash crop, and the practice of using it as a nurse crop for the "seeds" ley is extending. For this purpose flax is excellent, encouraging good "takes" of grass and clover, and since it is harvested in good time useful stubble grazing is obtained, which in turn assists materially to develop and establish the clovers. In the pastoral region of the North-west a considerable area of land has been ploughed out for cropping and also for direct reseeding. The aim here has been to make every farm self-supporting and, as a rule, with milk cows, each man has been encouraged to have (per cow) at least one-eighth of an acre under kale, one-quarter of an acre in roots or silage, half an acre in oats and three-quarters of an acre each of "seeds" for hay and grazing. In this district there is a comparatively high rainfall (over 40 in.) and direct reseeding has given impressive results, in spite of the natural herbage being noted for its good quality. Farmers have found that newly reseeded land has had three, four and five times the stock-carrying capacity. Of the 20,000 acres of land reseeded direct in the county, over 15,000 acres have been done in the western half. Two years ago the Committee initiated a scheme for carrying out reseeding at an all-in contract price of 11 guineas per acre. Three thousand acres have been completed within the scheme, and the percentage of failures or comparative failures has been negligible.

Pastoral country in the West Riding The march of the plough is clearly seen.

High-lying Pennine district Small farms on hungry soil are devoted entirely to stock-rearing and milk production The small fields and narrow lanes make access by machinery difficult Much of this class of land has been reseeded under contract

[Photos. H. I. M



[Photo H. I. Mo

Intensive dairying of the industrial area The market for liquid milk is on the doorstep of the farm

FIVE GENERATIONS (See pp. 30-32)

[Photo. G. S. McCann

Left to Right—

Sally Wild Eyes 28th, born 8/4/1929
Sally Wild Eyes 34th, born 14/11/1932
Lifton Wild Sally 16th, born 30/11/1937
Lifton Wild Sally 26th, born 28/2/1941

Silage has also played an important part in the campaign for self-sufficiency, though most farmers in the area prefer to have roots to feed in conjunction with the oat straw. The bulk of the silage made is usually of aftermath grass, and the present tendency is to convert buildings into silos or to erect permanent structures.

In the industrial districts the intensity of stocking is so great that few farms can attain more than a measure of self-sufficiency. The cow population is often as high as one per acre—and this on land that before the war was classified as exercise ground. Here it was common in the generous days of peace for the cows to receive 14 lb. of balanced rations per head per day, winter and summer alike. Nevertheless, ploughing out has helped considerably, and reseeding has proved of immense value. To-day productive new leys are steadily replacing the old brown impoverished pastures.

In general, the livestock population of the county has been maintained, and last year the milk target set by the Ministry was reached. There has been, however, a considerable reduction in sheep, especially in those districts which, before the war, were wholly in grass.

Milk production is largely by producer-retailers or wholesalers on the outskirts of a valuable industrial market. The average yield per cow of 1¼ gal. per day, though not high, must be considered fairly satisfactory for this area under war-time conditions. Much more could be achieved by the wider adoption of milk recording, by the use of proven bulls from dairy herds and by a sound breeding policy.

Inaccessible Hill Farms

Part of the area includes the high Pennine region, where the size of farms is usually under 50 acres. Here the land is inherently poor, and before the war there was a complete absence of arable equipment. In regions of this type the Committee operates machinery on a contract basis. A serious problem on these small farms has been their relative inaccessibility. For instance, gateways were too narrow to allow tractors and implements to pass through, and many of the lanes leading to the homesteads were too narrow to take the passage of threshing tackle; indeed frequently the amount of threshing per farm scarcely justified the visit of a tractor. Throughout the Riding private contractors have been encouraged to increase and extend their business, the Committee merely functioning where this has not been possible.

Widening Scope of Technical Education

One of the most encouraging features of war-time farming in the West Riding is the acceptance of technical development by the farming community. Yorkshire has always had a very efficient advisory service centred at the University of Leeds, and the setting up of the Technical Development Committee has enabled the work to be greatly extended and strengthened. Each district has its own T.D. sub-committee, composed of the foremost farmers in the district—men chosen for their keenness and energy and willingness to try out new methods and new materials. An Advisory Officer is attached to each committee. The main Technical Development Committee at headquarters has the task of feeding the district T.D.Cs. with all the material they require for demonstrations, farm walks and so on. The Advisory Officers are kept in close touch with the latest research by a series of quarterly conferences. Comprehensive variety of cultivation and manurial trials and other detailed experimental work is centred on twelve farms run privately and distributed over the whole Riding. On these farms major "field-days" are held from time to time, to which farmers

from a wide area are invited. In this way district Committees are kept in close touch with modern practice. The field trial centres constitute the experimental farms for the district, but do not suffer from the criticism that they are financed by public funds or are in any way distinct from normal farm practice. The central Committee also publishes a monthly bulletin, the object of which is to bring the most recent information within reach of all farmers in the county.

Discussion Societies and Listening Groups More recently, discussion societies have been formed, each Advisory Officer (of whom there are 23), being responsible for three or four in his area. These meet monthly during the winter and are addressed by the leading technicians and agriculturists of the county. During the summer the work is continued with farm walks. Still more recently Group Listening to broadcast talks has been encouraged, with the object of extending the scope of technical education. After the broadcast the Group Leader opens the discussion and makes himself responsible for a lively debate. The homely atmosphere of these meetings has much to commend it, and the recent *Farming To-day* series with its complementary printed synopsis and suggested list of questions helps materially to stimulate interest.

In this county we can look forward to the future with confidence. The four-year programme enunciated by Mr. Hudson will be greatly facilitated by the fact that farmers fully appreciate the value of the grass ley as a crop, and equally that it is a potent factor in the maintenance of soil fertility. We have travelled a long way since 1939: from now on our work will consist largely of consolidating the substantial gains that we have made.

FIVE GENERATIONS

J. H. Faulder, B.Sc., N.D.D.

Cumberland War Agricultural Executive Committee

FREQUENTLY one of the chief items in milk production costs is depreciation of the herd. The average life of a dairy cow in a milk herd is far too short, due principally to such diseases as mastitis, contagious abortion and sterility, and tuberculosis

The campaign of the Ministry of Agriculture for the prevention and eradication of animal diseases has recently been intensified by propaganda, education and demonstrations. In addition, the Ministry has sponsored a Veterinary Panel Scheme, under which periodic inspections of herds by a competent veterinarian gives the best chance of early diagnosis of incipient disease and hence early treatment. In some quarters this scheme is criticized on account of the cost to the farmer, but in these days, with dairy animals at the price they are, the cost would seem worth while and a sound insurance. Veterinary science is now doing much, and is capable of doing much more, to improve the health of our herds—thus assisting in the reduction of the appalling wastage among dairy cows. How fully its help can be enlisted depends greatly upon the measure of co-operation given by dairy farmers.

Wreay Herd Nucleus at Bell Mount Stamina or constitution of an animal is the result of skilful breeding, coupled with sound herd management. The pedigree dairy shorthorns shown in the photograph facing p 29 aptly illustrate this and provide a fine example of good stockmanship. Mr. Edward Jackson of Bell Mount, Penrith, the owner of the animals, is the son of the late Mr. Walton Jackson, The Wreay, Wigton, who will be remembered as a noted Shorthorn breeder. At the dispersal sale of The Wreay herd on October 1, 1942, the average price for 59 animals was £264—a record figure.

Mr. Jackson commenced farming on his own account at Clifton, near Penrith, taking with him about 30 pedigree Shorthorns from The Wreay, mostly of the "Wild Eyes" family, including "Sally Wild Eyes 28th". In February 1936, Mr. Jackson came to Bell Mount, bringing with him "Sally Wild Eyes 28th," and her daughter "Sally Wild Eyes 34th". Bell Mount is 125 acres in extent, but Mr. Jackson also rents 15 acres of adjoining land. His tillage acreage has, of course, been increased during the war ; in 1943, 45 acres were in tillage crops. To-day the farm carries 73 head of pedigree Shorthorns, all but two belonging to Bates's families, of which 35 are cows and heifers in calf or in milk. The herd became attested in 1938 ; and in 1939, owing to the restriction in the sale of cream, Mr. Jackson commenced selling Tuberculin Tested milk.

The two older cows in the picture are in calf and wintered out during the past season. "Sally Wild Eyes 28th" was born on April 8, 1929, and to date has bred 12 calves. Born at The Wreay, she was sired by the Register of Merit bull, "Ireby Warrior" ; she qualified with her first calf, though unfortunately she contracted a sore udder and lost a quarter. Her first calf, "Wild Eyes Swell," was used very successfully in the Parkside Allendale herd, eventually proving a Register of Merit sire. The second calf is "Sally Wild Eyes 34th," shown in the picture. In the eighth lactation, although having only three effective quarters, "Sally Wild Eyes 28th" gave over 1,000 gal. (more than 900 gal. were given in 315 days). "Sally Wild Eyes 34th" gave over 800 gal. in 315 days. "Lifton Wild Sally 16th" has not yet qualified. "Lifton Wild Sally 26th" (fourth generation) shows promise to qualify with a satisfactory margin.

Dual Purpose Aimed At Mr. Jackson commenced officially recording his herd 12 years ago. Though he has never set out to obtain maximum yields by forced feeding, his herd average over the years varies round 700 gal. per cow. Cows purchased from this herd to go South have usually given high yields under more intensive feeding and more congenial climate.

The main objective in breeding is to produce bulls suitable for sale and cows which will carry a reasonable amount of flesh and give round about 800 gal. of milk, while breeding a calf each year. The butter-fat content in the milk is not overlooked, Mr. Jackson being keenly alive to its importance.

There have been no serious disease problems at Bell Mount. Occasional cases of sore udder have occurred—usually in August or September.

Mr. Jackson rarely purchases a female and quite frequently uses a bull of his own breeding as his stock bull. While he does not believe in close in-breeding, he is a staunch believer in line breeding, and as a result his herd is extremely uniform and of one type.

No strict rationing is practised, although in feeding concentrates attention is paid to milk yields.

During the past year, the sales, which frequently are by private treaty, included the following animals:

"Wreay Wild Eyes 47th"—10 years old;

"Thornby Fogathorpe 43rd"—11 years old (a 2,000-gal. cow, which averaged 1,100 gal. with 8 calves);

"Lifton Wild Sally 3rd"—10 years old (averaged 800 gal. with 7 calves);

"Wreay Wild Eyes 60th"—10 years old (another 1,000-gal. cow).

Mr. Jackson has retained in his herd a number of his best animals for breeding purposes, and these examples show that his cows not only milk well but also wear well.

The picture also indicates that the males bred from such cows, if not required for breeding, would make satisfactory beef animals. In short, the herd may be described as dual-purpose.

HISTORY OF A LUCERNE CROP

H. H. MANN, D.Sc., F.I.C.

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THE value of lucerne as a forage crop has been recognised all over the world, and it is now largely grown in many of the countries of Europe, Asia, and especially America. In England, however, extension of its cultivation has been slow. Whether this is due to the cost of seed, to the fact that so many of the soils of this country are slightly acid, or to the special difficulty of the weed problem, it is difficult to say. The introduction of inoculation of the seed before sowing has made possible the growing of the crop in many areas where previously it had been a failure, and the use of lime to prepare the soil has probably assisted in establishing a plant of lucerne in fields where it would otherwise have been impossible. Information as to what can be expected from a crop of lucerne, and how long a planting may normally be expected to last is, however, singularly lacking, and the records of a successful crop that have been kept at Woburn for eight years may be of interest.

The plots, of which an account follows, were originally sown down as a test of the inoculation method devised by Dr. H. G. Thornton of Rothamsted. It was quickly found, however, that the soil was already well enough supplied with the necessary bacteria and that, consequently, there was little difference between the growth of the crop from inoculated seed and that from untreated seed. This question therefore became secondary in the experiment, which remained primarily a test of the returns that could be expected from a good plant of lucerne in the drier half of England.

Soil and Seed The soil on which the lucerne was grown is a light loam over-lying sand. It is well drained and there is no water table, though there are streams of wetness at 4–6 ft. below the surface. The soil is deficient in lime and is slightly acid (pH 5·8), though not sufficiently so to make it difficult to establish the lucerne. The lower layers are less acid than the surface (the subsoil at 12–18 in. has a pH value of 6·3), and nowhere did the crop show any sign of suffering on account of acidity, even though no lime was applied in the course of the experiment.

The figures given later are based on the mean results from twelve plots, of which six were inoculated and six were sown without pre-treatment of the seed.

The land selected for sowing had borne a crop of oats the previous year and was in fairly good condition. Before the experiment was started it was tractor ploughed in October, and then cultivated and harrowed whenever possible through the winter. At the time of sowing (April 21), the tilth was fine and the surface dry, but the soil was satisfactorily moist underneath.

The seed chosen was Grimm lucerne. The inoculated seed had been treated on April 13 and dried ready for sowing. The seed, mixed with double its weight of mustard seed, was sown in drills 9 in. apart, at the rate of 20 lb. per acre. From later experience it would appear that the mixing of the seed with mustard was a mistake; we never have any difficulty in getting a good plant of lucerne by sowing the seed alone at the above rate. In any case, the mustard was cut with a mowing machine on June 27 and left on the land.

Keeping the Crop Clean It is recognized by lucerne growers that the greatest enemy of the crop is weeds, chiefly grasses, and that a very important part of the maintenance of a lucerne crop is to prevent their growth. Luckily, once the crop is established, it will stand almost any amount of hard harrowing in the off-season, and at Woburn winter harrowing was the chief method relied on to keep down the grass and other weeds. A harrowing was usually given after the removal of every cutting, and in winter the harrowing was frequent and severe. The following are the cultivations that took place in the winter following the year of sowing, when the crop was fully established. After the second crop was taken off in the early part of October, the plots were cross-harrowed on December 2, again on March 22, and again on April 8, and they were hand-hoed between the rows in the latter part of April. The land was finally double-harrowed on May 10, and was then left for the first crop of lucerne. With minor modifications, a similar series of harrowings was given in each subsequent winter.

Manuring As to manuring, the land was in fairly good condition when the lucerne was sown, and so no manure was added. Lime would usually be applied, but it was desired to see how far lucerne would flourish at a *p*H value of 5·8, and therefore no lime was used. In fact, no manures were given for the first three years, and after this the treatment was as follows:

4th year	..	10 tons farmyard manure per acre, applied in January, before the beginning of the cropping year.
5th year	..	No manure.
6th year	..	10 tons farmyard manure per acre, applied in January, before the beginning of the cropping year.
7th year	..	9¼ tons farmyard manure per acre, applied early in February, before the beginning of the cropping year.

In each instance the farmyard manure was spread on the land and allowed to lie, being partly harrowed in by the late winter harrowing. Thus, in the course of the eight years during which the land was under lucerne, 29¼ tons of farmyard manure were added per acre. This means that at the rate of 15s. per ton of manure the value of the manure applied during eight years was about £22 per acre.

Two or Three Crops each Year As already stated, the first crop was taken on August 15, that is, 116 days after the seed was sown. A second cut (although small) was taken in the first year, after which the crop was fully established. It gave two crops in the second year, and after this three crops were cut each year until the last. The first two crops were made into hay and the third was fed green, as it was impossible to make hay in October or November. The weight of green lucerne obtained in this cutting was calculated as an equivalent of hay, and all records now given are of lucerne hay with a normal moisture content of 15 per cent. The lucerne was not grazed at any stage.

Until the fifth year, the lucerne remained fairly clean, but from this time the amount of grass gradually increased in spite of the severe harrowing, so that the last year's produce contained a good deal of grass. At the end of the seventh season, it was evident that the lucerne was becoming exhausted, and gaps appeared in the plant. This was still more marked in the following year, and the whole was therefore ploughed up at the end of that season.

High Yields of Hay The yields of lucerne per acre in each year and for each crop are shown in the following Table:

Table 1. Mean Yields of Hay per Acre.

YEAR	1ST CROP	2ND CROP	3RD CROP	TOTAL CROP
	tons	*tons*	*tons*	*tons*
1st	0·65	0·13	—	0·78
2nd	2·06	1·14	—	3·20
3rd	2 60	1·01	0·40	4·01
4th	4·03	2·10	0·38	6·51
5th	2·35	1·58	0·40	4·33
6th	2·93	1·31	0·76	5·00
7th	1·93	0·98	0·36	3·27
8th	2·06	1·38	—	3·44
Total in 8 years	18·61	9·63	2·30	30·54

Thus in the course of eight years, there has been taken from this land over 30½ tons of hay per acre. Of this, 61 per cent. was obtained in the first crop, 31½ per cent. in the second crop and 7½ per cent. in the third crop. (These percentages exclude the first year, when the plant was not really established.) The mean date of the first crop was June 8; of the second, August 17; and of the third, November 5. The cuttings were made as near as possible to the time when the lucerne was in full flower. The mean yield per annum for eight years was 3·82 tons of lucerne hay per acre. This is a high yield of hay for a period of eight years from one sowing, and is especially so when it is considered that the land was not heavily manured.

Nutritious Feedingstuff Lucerne hay is, moreover, of high feeding value. The mean percentage of nitrogen and of protein in the dried material from nearly all the crops is shown on the next page.

TABLE 2. PERCENTAGE OF NITROGEN AND OF PROTEIN IN DRY MATERIAL

YEAR	1ST CROP		2ND CROP		3RD CROP		TOTAL	
	Nitrogen	Protein	Nitrogen	Protein	Nitrogen	Protein	Nitrogen	Protein
1st	—	—	2·71	16·9	—	—	2·71	16·9
2nd	2·45	15·3	2·71	16·9	—	—	2·58	16·1
3rd	3·04	18·9	2·76	17·3	2·44	15·3	2·75	17·2
4th	3·29	20·6	2·76	17·3	2·94	18·4	3·00	18·8
5th	3·11	19·4	?	?	2·82	17·6	2·96	18·5
6th	2·64	16·5	3·08	19·3	3·64	22·7	3·12	19·5
7th	2·96	18·5	2·92	18·2	2·92	18·2	2·93	18·3
8th	2·72	16·9	3·09	19·3	—	—	2·91	18·1
Mean (except 1st year)	2·88	18·0	2·86	17·9	2·95	18·5	2·90	18·1

(The above figures are for the completely dried material. In the hay, as used, containing 15 per cent. of moisture, the mean nitrogen contents were as follows: first crop 2·45 per cent.; second crop 2·43 per cent.; third crop 2·51 per cent.; total 2·46 per cent.)

There appears to be little difference between the protein content of the different crops, and in all cases the hay derived from each of them contains about 2½ per cent. of nitrogen and 15½ per cent. of protein. Except in the first year (when the inoculated plots were distinctly higher in protein), the inoculated plots showed little difference from those which were not inoculated. When this richness in protein is taken into account, and also the fact that 30½ tons of lucerne hay per acre have been obtained in eight years, it will be seen how valuable the lucerne crop may be on light but deep soils in England.

Drought Unlikely to Affect Crop Once established, and provided it can get its roots deep in the soil, the lucerne crop seems to be unaffected by drought. There are records in America of lucerne drawing its water from a depth of 33 ft., while irrigation at 10 ft. deep has been found effective for the crop. Here in England, records of root depth are much less spectacular. In the present crop, the deep roots went straight down as single ropes to about 2½ ft. Below this, they penetrated to about 5 ft. where they met a hard layer with limonite slabs. They did not appear to be able to penetrate this layer, but there was much development of fibrous roots. This amount of penetration nevertheless indicates that lucerne plants can withstand any drought that is likely to occur in England.

ARMY FOOD PRODUCTION

IN the autumn of 1940 the Army Council decided to undertake the cultivation, as far as possible, of all land occupied by the War Department, including the gardens of requisitioned houses where the owners themselves were unable to do the work. It was intended that the hand cultivations should be done largely by troops on the spot in their spare time, but it was realized that some skilled supervision and whole-time work would also be necessary if the best results were to be obtained. Officers were accordingly selected and appointed to Commands and Districts to implement the policy of food production by the Army. The majority of these officers are land agents or farmers in civil life.

A certain number of soldiers with agricultural or horticultural experience were also allotted to Commands, to advise units and help them with the preparation and cultivation of the land. These men have been of inestimable value in teaching the uninitiated the craft of market-gardening, and it is to their skill and enthusiasm that the development of many plots of derelict land into prosperous allotments must be attributed. A word of praise is also due to Agricultural Officers, who in spite of many difficulties, such as the constant movement of troops, have built up a very live organization. These officers are responsible for purchasing and distributing seeds, tools, plants and fertilizers to units, and for stocking and farming the large tracts of land in various parts of the country that have come under the control of the War Department. Much of their time is also devoted to visiting units and giving advice and help in every way possible.

Help from W.A.E.Cs. and W.L.A. War Agricultural Executive Committees, with whom close liaison is maintained, have rendered valuable assistance, both by carrying out cultivations under the scheme and hiring out implements. The Army is indebted to them also for their ever-ready help and advice regarding the cropping of difficult land, labour and a hundred-and-one other problems which inevitably arise in a scheme of this nature. The Women's Land Army have also co-operated willingly, and several land girls are engaged on work under the scheme, including tractor driving.

Finance The scheme is financed by the Treasury. At the commencement of each calendar year advances are made to Commands at the rate of £10 per acre for the purchase of seeds, fertilizers, machinery and implements. At the end of the year these advances are repaid out of the sales of crops and live stock and, after deducting the cost of certain overhead expenses, the balance is shared equally between public funds and Commands for the benefit of those units which participated in the work. The dividend thus earned by units is spent on amenities for the troops.

Cropping Approximately 13,000 acres of land have been cultivated under the scheme, potatoes being the main crop and comprising roughly 50 per cent. of the total. Cereals, brassicas and root crops are also grown in rotation. Glasshouses in the gardens of requisitioned property have been fully utilized, and considerable quantities of tomatoes have been produced. Several of these gardens are used as a "mother" garden, where seedlings are raised and later distributed to units, and many are under the

supervision of a civilian gardener who has been employed on the property since before the war. These men take a great interest in the scheme, and at busy times they may call for assistance from a soldier gardener. The old retainer and his Army friend get on well together; both realize the importance of the job they are doing, even though their methods of doing it may differ at times.

Mechanization Machinery and implements required under the scheme are purchased by the War Office through the Ministry of Agriculture. At the present time 43 tractors and 70 small hand-tractors are fully employed in the various Army Commands and Districts throughout the country. Hand tools are bought locally by Agricultural Officers, allocated to units and held on charge by them.

Disposal of Produce Produce grown under the scheme is usually disposed of by the under-drawal of the normal ration entitlement of potatoes and vegetables issued to units; that is to say, instead of drawing their requirements from a N.A.A.F.I. supply depot, the Messing Officer arranges with the Agricultural Officer for a supply of produce grown by the unit. The vegetables go straight from the garden to the cook-house, thus saving petrol and transport and providing the troops with a considerable variety of fresh vegetables. The dietetic value of eating such fresh vegetables is well understood by the men, and they are greatly appreciated—particularly where it is possible to arrange for an even supply throughout the year.

Surplus produce is sold to the N.A.A.F.I. and occasionally to outside buyers, but to avoid competition with local market-gardeners resort is only made to the latter in exceptional circumstances. Farm crops, however, are sold in the usual way and in compliance with the regulations laid down by the Ministry of Food. On a number of properties, live stock, particularly cattle, sheep and pigs, have been taken over, and by balancing stock and crops, the fertility of the land is being safeguarded.

"Mitchellhill" Trophy and Cups In the spring of 1943 Mr. J. P. Mitchellhill presented a cup for the best unit garden in each Command and a trophy for the best unit garden in the whole country. This generous gesture has stimulated interest in the scheme and provided a healthy competitive spirit between units. The judging was a somewhat unenviable task, as so many factors had to be taken into consideration, such as utilization of the ground, the amount of unit labour available, cropping plans and lay-out, quality of produce, pest control, care of tools, and records and accounting.

The judging was completed towards the end of the summer, and on October 20, 1943, Mr. Mitchellhill presented the trophy to the winning unit—an Officers' Training School in the Midlands. Under the personal direction of its Commanding Officer this school has turned a one-time wilderness into a flourishing kitchen garden. Winners of the Command Cups included

units of The Royal Artillery, Royal Electrical and Mechanical Engineers, the staff of a Prisoners of War Camp and a Canadian Engineer Construction Company.

The Mitchellhill Cups and Trophy will again be competed for this year, when it is expected that many more units will vie with each other for the honours.

Progress of the Scheme The following figures give a rough idea of the progress made by the scheme since operations were commenced in the early spring of 1941:

Year Ended	Acreage	Value of Produce Sold or Consumed
		£
December, 1941	5,676	103,562
December, 1942	9,727	228,838
December, 1943	12,273	371,893

ALTERNATIVES TO SULPHURIC ACID FOR THE CONTROL OF ANNUAL WEEDS IN CEREALS

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It must be stressed that in many ways this article is in the nature of a progress report. Developments in the field of chemical weed control are likely to be rapid and the conclusions reached radically altered after a further season's experiments. Other compounds are being investigated and the programme extended to cover a wider range of weeds and new crops. It would, therefore, be unwise for farmers to anticipate the results of research for the attempts may be disastrous—applying the recommendations for cereals to other crops may lead to killing both the weeds and the crop.

Although numerous substances have been recommended for eradicating weeds from cereal crops, most of them have not stood the test of time and practice. Of those which have survived, copper sulphate, powdered cyanamide and sulphuric acid have been most extensively employed. Copper sulphate has the merit of simplicity coupled with ease of handling, but suffers from the disadvantage that it can be used only against a few weed species, such as yellow charlock. Moreover, for success, at least twenty-four hours of fine weather are required after spraying. Cyanamide, unobtainable in war-time, can control a wider range of weeds, provided that the powder is applied under conditions where the material adheres to the weeds and rain does not wash it off too soon.

Progress with Acid Spraying in Past Decade It is more than ten years ago that the first extensive experiments were carried out with sulphuric acid in this country. Since then the technique of acid spraying has made great strides, largely because the

spray acts quickly and it can be used against many kinds of annual weeds. On the other hand, no one can deny that sulphuric acid has obvious disadvantages. In dilute solution it is highly corrosive to metals and clothing, and the concentrated acid requires careful handling and mixing. It was against this background that research, under grants from the Ministry of Agriculture and the Agricultural Research Council, was undertaken at the Imperial College to find alternative compounds which will act quicker than copper sulphate and are less corrosive than sulphuric acid.

To set out all the results so far obtained is not the purpose of this article, because some of the most promising compounds are still in an early stage of development. However, with other substances the results for some weeds are so clear cut as to warrant limited recommendations for their use in agricultural practice. Two phases of the work in which most progress has been made are concerned with the relative merits of copper salts and the value of dinitro-ortho-cresol compounds. Dinitro-ortho-cresol itself, often abbreviated to D.N.O.C. or D.N.C., is an active constituent of the oil wash used for late winter spraying of fruit trees and gives the spray its characteristic bright yellow colour. Dinitro-ortho-cresol is also the starting point for the manufacture of yellow dyestuffs, so it is not surprising that this product and its compounds stain skin and clothing.

With both copper salts and dinitro-ortho-cresol compounds, the investigations have brought out the cardinal importance of their chemical composition. A relatively small change may make all the difference between effectiveness and ineffectiveness. For example, copper chloride is much superior to copper nitrate, and this in turn is superior to copper sulphate, alone or mixed with agricultural salt. Again the sodium salt of dinitro-ortho-cresol is far less effective than the ammonium salt, but the efficiency of the sodium salt can greatly be improved by the addition of ammonium sulphate.

Better Control with Copper Chloride

As to the application of these results in agricultural practice, the recommendations are dependent on the weed, the cereal crop and the facilities available. Where copper sulphate has been used for yellow charlock in spring cereals, a change to copper chloride has many advantages. Copper chloride acts quicker and is therefore less dependent on fine weather after spraying for good results. There is a saving of copper—an important feature in war time—for the experiments have shown that a 1 to 2 per cent. spray of copper chloride is more effective for charlock control than a 5 per cent. solution of copper sulphate. Copper chloride, in contrast with sulphuric acid, maintains its effectiveness, even when spraying is delayed, until the charlock is in flower. Late spraying should, however, always be avoided, because the longer spraying is delayed the greater is the damage done to the crop by the charlock.

This superiority of copper chloride over copper sulphate also holds for other annual weeds. Copper sulphate, even at concentrations of 8 per cent. does not kill that most aggressive weed of lighter soils—which is rightly called so many names—white charlock, runch or wild radish. On the other hand, copper chloride may give a fair and even a good control at strengths of 2–4 per cent., provided that white charlock is sprayed in the four-leaf seedling stage. Procrastination in spraying is, in this instance, the thief of efficiency, and once the plants have become many-leaved rosettes, poor kills are the result. The same advice holds for the eradication

of field speedwells (*Veronica* spp.) and black bindweed or bearbind (*Polygonum convolvulus*). With concentrations up to 4 per cent., early spraying gives good control, but an attempt to make up for late spraying by increasing the concentrations of copper chloride is dangerous. *Concentrations of copper chloride in excess of 4 per cent. depress the yield of spring-sown corn crops and are most damaging to barley.*

Effectiveness of Ammonium D.N.O.C. The experiments with the ammonium salt of dinitro-ortho-cresol have already demonstrated that this compound is capable of eradicating several of the commoner annual weeds in cereals. A solution of 0·8 per cent., applied at the rate of 100 gal. per acre, controls yellow charlock, white charlock, corn poppies, fumitory (*Fumaria officinalis*) common hemp-nettle (*Galeopsis Tetrahit*) and wild orache (*Atriplex patula*). The results for corn poppies, and to a less extent for fumitory, are of special interest, since sulphuric acid, even with the addition of a wetting agent, cannot be considered wholly effective against these two weeds. Moreover, sulphuric acid, at the concentrations required for white charlock and poppies may, on the lighter soils and in a dry season, decrease the yield of barley. But as far as the present experiments go, ammonium dinitro-ortho-cresol does not have this disadvantage.

No mention has yet been made of those weeds that have been found to be resistant. Any conclusions so far reached must be taken as tentative, since it cannot be ensured that by increasing the concentration or by spraying earlier a better control might not sometimes have been obtained. Nevertheless, for the guidance of those wishing to explore the possibility of killing other weeds in spring cereals the results at present indicate that wild onion, knotgrass (*Polygonum aviculare*) and willow weed (*Polygonum persicaria*) are resistant.

War-Time Substitute for D.N.O.C. With war-time difficulties, the ammonium salt of dinitro-ortho-cresol may be in short supply, but a good substitute can be made up by taking 8 lb. of the *sodium* salt, adding 10 lb. of ammonium sulphate and dissolving the whole in 100 gal. of water. This solution of the "activated" sodium salt has been found to be nearly as effective as the ammonium dinitro-ortho-cresylate at 8 lb. per 100 gal.

Sulphuric Acid Still Best for Winter Wheat Weeds Although copper chloride and ammonium dinitro-ortho-cresol can, under certain conditions, take the place of sulphuric acid for the control of several weeds, it is erroneous to infer that they are always equally effective. In fact, the evidence is quite to the contrary. For the destruction of weeds in winter wheat, such as corn buttercup or starveacre (*Ranunculus arvensis*), they are inferior, slower acting than sulphuric acid and not at present recommended. It is only when the temperature rises later in the spring that ammonium dinitro-ortho-cresylate, in particular, reaches its maximum efficiency; in fact, on a really warm day, this chemical and copper chloride act nearly as quickly as sulphuric acid.

Precautions with Copper Chloride and D.N.C. Although it was one of the main objects of the investigation to find alternatives to sulphuric acid which are easier to apply, it must not be assumed that precautions are unnecessary. Copper chloride, even though it does not harm the skin and has little effect on clothing,

is yet corrosive to metals and metal alloys. *In fact, dilute copper chloride is more corrosive to most metals than sulphuric acid.* It is therefore essential to wash out thoroughly all machinery after spraying.

Ammonium dinitro-ortho-cresol or the *activated* sodium salt do not have this disadvantage of corrosiveness but they have other drawbacks. In handling, care should be taken not to get the skin too frequently and too lavishly stained bright yellow. Some staining—which is of a temporary nature—is unavoidable, but a complete disregard of precautions, especially on contract work, may be harmful. *No attempt should be made to clear the nozzles or pipes on the machine by sucking or blowing through them with the mouth, since dinitro-ortho-cresol compounds are all poisonous when swallowed.*

Dinitro-ortho-cresol compounds, when dry, are highly inflammable, and for this reason they are commonly sent out as water pastes containing up to a 50 per cent. concentration. Half-used containers should never therefore be allowed to dry out, and spraying machines after use should not only be washed out, but also hosed down to prevent dry spray material collecting on the outside and catching fire. Similarly, the clothing of operators which become saturated with the spray should be washed. Washing will not, however, remove the yellow stain, which on woollen garments is almost permanent. Old clothes should, therefore, be worn whenever possible, together with gumboots, a rubber apron and rubber gloves.

REARING AND THE BREEDING CAPACITY OF PIGS

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For the purposes of this article, pigs which are *well nurtured* when young, and therefore at that stage grow rapidly and keep in good condition, are referred to as "well-reared" pigs. Those which are *indifferently nurtured* when young, and therefore at that stage grow slowly and fail to retain their "bloom," are described as "badly reared" pigs.—Ed.

ANIMALS which are fed liberally when young make better growth than those reared on a comparatively low standard of nutrition. Generally, the difference is sufficiently great to be apparent to the eye, and frequently it persists throughout life. Many breeders go farther and contend that well-fed young animals develop a superior breeding capacity. Others, however, contest this opinion. At present, when suitable feedingstuffs are in short supply, many young animals which are to be used for breeding are reared on a very low standard of nutrition. Results recently obtained with pigs at Wye indicate the danger of this practice.

Between 1939 and 1942 a number of war-time rations for breeding stock were tested at this Station[1], and considerable economies in meal consumption were effected by their use. Sows receiving these rations reared satisfactory litters, but their weights at weaning were lower than those of pre-war litters. The difference was marked in the best litters (that is, those from which gilts were saved for breeding); in this class of litter the weaning weights were frequently 20 per cent. lower than the

pre-war figures. From this the question naturally arose whether the breeding capacity of the gilts was also reduced. A watch was kept for evidence upon this point and the three examples cited below were obtained.

Example 1 In 1941 an Essex saddleback sow (E 52) produced a litter of 9 pigs. She was fed to a low war-time standard* and reared (badly) 7 of the pigs. The litter weighed no more than 197 lb. when weaned at 8 weeks old. As is frequently the case with badly reared, small litters, the pigs were uneven. Two gilts were saved for breeding from this litter : E(1941) 1, which had appropriated two teats and was a "well-reared" gilt, weighing 34½ lb. at eight weeks old, and E(1941) 4, which secured only one teat and was "badly reared", weighing 29½ lb. at eight weeks old. With their first litters the well-reared gilt produced 9 pigs, whereas the badly reared gilt produced 3 pigs.

Example 2 In 1941 an Essex saddleback sow (E 39) produced a litter of 10 pigs by "Benton Chieftain". She was fed to what was considered to be the war-time optimum standard†, and was allowed to take her piglings out to graze. Her litter was well reared, and weighed 339 lb. when weaned at eight weeks old. Two well-reared gilts were saved from this litter, E(1941) 27 and E(1041) 28. The former weighed 38½ lb. and the latter 34½ lb. when weaned at eight weeks old.

In 1942 sow E 39 produced another litter of 10 pigs sired by the same boar. E 39 and her 1942 litter were kept indoors and fed to the low war-time standard. She reared the litter badly, and the pigs weighed only 237 lb. when weaned at eight weeks old. Three badly reared gilts were saved from this litter, E(1942) 19, E(1942) 23 and E(1942) 24, which weighed 24½ lb., 25½ lb. and 27 lb. respectively at eight weeks old.

With the first litters of the above 5 gilts, the well-reared gilts E(1941) 27 and E(1941) 28 produced 12 pigs and 13 pigs respectively, whereas the badly reared gilts E(1942) 19, E(1942) 23 and E(1942) 24 produced 9, 7 and 2 pigs respectively.

Example 3 In 1942 gilts were saved for breeding from the litter of a large white gilt W(1941) 29. She produced 11 pigs, from which 5 were removed within twenty-four hours of birth. The remaining 6 pigs were moderately well reared up to the age of eight weeks, when four gilts were selected for breeding, W(1942) 31, W(1942) 32, W(1942) 34 and W(1942) 35. They weighed 29½ lb., 29½ lb., 27½ lb. and 26 lb. respectively. W(1942) 34 and W(1942) 35 were weaned at that age, W(1942) 31 and W(1942) 32 were suckled by their dams until they were twelve weeks old. The latter two gilts did well and weighed 62 lb. and 60 lb. when twelve weeks old and must be regarded as having been well reared. W(1942) 34 and W(1942) 35 failed to develop a normal appetite after weaning and made little growth, weighing only 35 lb. and 38 lb. respectively at twelve weeks old. They must be regarded as having been badly reared. In their first litters: the well-reared gilts W(1942) 31 and W(1942) 32 reared 9 and 12 pigs respectively ; the two badly reared litter sisters W(1942) 34 and W(1942) 35 were barren.

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* *Low War-time Standard.* Barley meal 60% ; Sharps (or finely ground oats) 30% ; Pea or bean meal 10%, plus 1¼ lb. chalk and ½ lb. salt per 100 lb. mixed meal. Of this, the sow received 3 lb. per day plus 4 gal. of boiled swill.

† *War-time Optimum Standard.* Barley meal 50% ; Sharps (or finely ground oats) 30% ; Pea or bean meal 20%, plus 1¼ lb. chalk and ½ lb. salt, per 100 lb. mixed meal. Of this, the sow received 5 lb. per day, and she and her litter had free range on good pasture.

Grazing, Smaller Litters and Longer Suckling These three cases suggest that the breeding capacity of a gilt may be influenced by unsuitable feeding whilst the animal is young; and pending the results of further investigations it would be wise to ensure that all gilts from which it is intended to breed are "well reared". In this connexion three simple expedients are helpful.

1. Piglings which with their dam have free range over clean grassland grow better than similar piglings reared indoors[2]. Therefore, whenever possible, litters containing gilts intended to be used for breeding should be allowed out to graze.

2. With litters containing gilts to be used for breeding, the number of piglings should, if necessary, be reduced to that which the sow can rear well, having regard to the feedingstuffs available. (A gilt intended for breeding should weigh not less than 30 lb. at eight weeks old.)

3. Piglings which are suckled by their dams until they are twelve weeks old do much better between eight and twelve weeks than those weaned at eight weeks[3]. Therefore it is frequently advisable, under war-time conditions, to allow gilts which are to be used for breeding to remain on their dam until they are twelve weeks old.

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FRUIT TREE SPRAYING IN KENT

KENT WAR AGRICULTURAL EXECUTIVE COMMITTEE

DURING 1943 nearly 7,000 acres of fruit trees were sprayed with tar oil, petroleum and D.N.O.C. winter washes by machines operated under the control of the Kent War Agricultural Executive Committee, and well over 8,000 acres were sprayed in spring or early summer.

It is common knowledge that War Agricultural Executive Committees have machinery to help farmers "to plough and to sow and to reap and to mow," but it is not so well known that Committees in the principal fruit-growing counties have been provided with spraying machines in order that orchards lacking suitable equipment may be sprayed. It is unfortunate but true that even in Kent there are unthrifty orchards and fruit plantations in which pest and disease control has not been practised, so a spraying scheme should improve many orchards and increase fruit production considerably.

An adequate spraying scheme is not easy to organize because the work is seasonal and is practicable only when weather conditions are suitable. Also, continuous employment of machines and personnel in spraying cannot

be guaranteed for the six months of the normal fruit spraying season. The season embraces periods, such as blossoming time, during which work ceases, and periods during which the demand for service is extremely heavy.

Spraying on Contract A special Spraying Advisory Committee, established by the Kent War Agricultural Executive Committee, evolved a workable scheme whereby spraying machines supplied to the Committee are hired out to contractors, each of whom has been given a definite area to work. Some of the contractors were already engaged in ploughing, reaping and other contract work, and so were able to undertake another activity. It was found that spraying fitted in well with other farm work contracts. Other spraying contractors are young fruit farmers or sons of fruit farmers who wish to increase their income and help food production.

The contractor undertakes to spray any orchards in the area allotted to him at the request of the Committee's local Fruit Surveyor, and may also spray any other orchards in the area for farmers who lack equipment. The scale of charges laid down by the Committee has been accepted by all the contractors. A simple spray schedule has also been recommended. Growers anxious to have their orchards sprayed can apply either to the Committee or to its local representative, or they may approach the contractor directly.

Financial Arrangements The scale of charges laid down by the Committee provides for payment by the grower on an hourly basis, that is, the number of hours actually worked on spraying. Where estimates of the cost of spraying are required, a scale of charges on an acreage basis has been worked out, average costs of application of high, medium and low quantities of winter and spring washes per acre being set out. Washes are provided by the grower if he so prefers, or by the contractor on agreement. The grower is required to supply the water.

Labour Requirements Each machine requires a tractor driver who at times may operate one of the two spraying lances, though two persons, in addition to the driver, are usually provided for the lances.

Each contractor is responsible for the personnel required for his machine or machines. At first a number of land girls were given courses of training at East Malling Research Station, the Kent Farm Institute and two commercial fruit farms. Experience has shown that the girls must be chosen with considerable care for spraying work, both from the point of view of physique and of temperament.

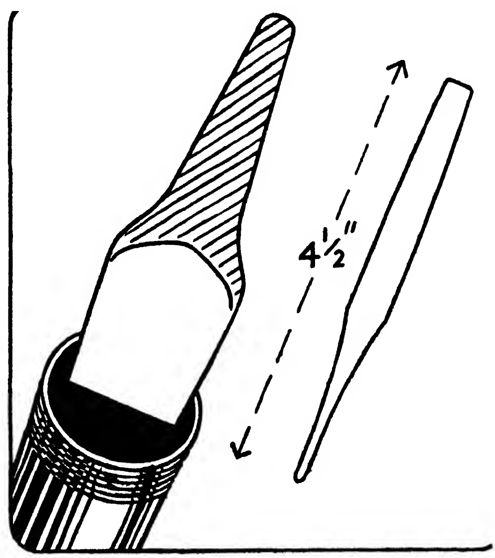
Work Done Quickly The spraying machines travel the orchards between the rows of trees, one operator spraying the trees to the left and the other those to the right. The work proceeds fairly rapidly, so that the average charge for application of washes is based on less than two hours per acre in winter and on about 1½ hours per acre in spring. The machines are fitted with tanks of 250 gal. capacity and are capable of delivering up to 15 gal. of spray fluid per minute. Over 50 of these fruit spraying machines are at work in Kent.

It will be realized that the Kent Committee is performing valuable pioneer work in developing a contract system for spraying orchards, and the experience gained will be of great value in extending the system in other areas.

GREASE AND FARM MACHINERY

National Institute of Agricultural Engineering, Askham Bryan, York

THE life of farm machinery and the reduction in repair bills depend to a very large extent on thorough lubrication with the correct grade of lubricant. There are, however, certain parts of farm implements, such as cutter-bars, tracks and sometimes chains, which have to work in dusty or gritty conditions. If such parts are lubricated excessive wear results, because the lubricant picks up grit and forms a grinding paste. With the above exceptions, all moving parts should be lubricated regularly. *Grease is cheaper than bearings.*



Grease should be stored in a clean container fitted with a lid, which should be kept on when the grease is not being used. If a clean piece of wood, shaped like a small spade (as illustrated), is kept in the grease container and used for removing grease, contamination by dirt from hands and grease guns will be avoided.

Operators should grease all implements systematically, starting at one place and working round the machine, so that no grease points are missed. This is especially important on machines such as binders and combine harvesters which have a large number of grease nipples. Each nipple should be wiped clean with a piece of rag before the grease gun is applied, thus preventing any surface dust or grit being forced into the bearing. The gun should be used until the grease is forced from the bearing; by so doing the old and dirty grease is removed and new, clean grease substituted.

The frequency with which the various implements or parts of implements should be lubricated is given in instruction books. If an operator is in doubt he should consult the chart *The Maintenance and Care of Farm Machinery*, published by the Ministry. This chart contains details of the lubrication, care, maintenance and storage of all farm implements, and can be obtained free and post free from the Ministry, Africa House, Kingsway, London, W.C.2.

YOU CAN SAVE FUEL FOR BATTLE . . .

by planning your cultivations, keeping your tractor in good order, and always driving it carefully.

FARMING NOTES

Salt for Haymaking The march of the seasons proceeds with a swiftness which allows us little time to pause in our labours. Soon we shall be thinking of hay harvest and hoping devoutly for the co-operation of fine weather. On this and the care with which the hay is made depends the excellence of next winter's fodder for our stock. But too often in these days of labour shortage and increased effort the job is likely to be rushed, with the result that seemingly green hay loses its colour and much of its feeding value in an overheated stack. This risk can be guarded against by the use of ordinary agricultural salt sprinkled when stacking at the rate of 20 to 40 lb. of salt per ton of crop. It is possible that with very narrow or ventilated stacks the lower rate would be sufficient.

It has been found that hay made with the "Solages" method, as this technique is called on the Continent, can be stacked 12 to 24 hours after cutting, thus reducing the risk of damage by rain ; all the leaf is preserved ; with increased palatability, wastage in feeding is insignificant ; and obviously it is a very convenient way of supplying stock with the necessary salt.

If you have not already done so, now is the time to order your requirements of agricultural salt, not only for haymaking, but for mangolds and sugar beet as well.

Farm Mechanization Mr. Clyde Higgs had something to say about haymaking when he presented his paper on "The Mechanization of the Mixed Farm" to the Royal Society of Arts on February 29, 1944. "The whole job," he remarked, "has to be crammed into a few days, and it is obvious that we make every effort to complete it . . . The old practice was to cut the hay, let it well bake on one side—that is, make sure that no nourishment was left in it at all—turn it over and repeat the process ; put it into a stack and then wonder why the cows wouldn't milk ! To-day it is cut and turned as soon as possible, so that it will dry more quickly . . . Hay sweeps take an important part on most farms. In some cases they are fitted to the front of an old car, and having tried this method and finding that old cars are very temperamental, I now fit my sweep to a tractor. It is not good for the tractor, which gets overheated, but as we all do the same at haymaking time it had to take its chance."

This, of course, is only one aspect of a single phase of mechanized farming, and one of the greatest problems which is at present exercising the minds of our agriculturists is the extent to which the small farm can be mechanized, and the type and classes of implements which can be brought within the reach of the small farmer. On this point Mr. Clyde Higgs's view is that the smaller the farm the more thorough should be the cultivations : he does not think that this high standard can be achieved without the use of a track-laying tractor.

The three things which would most help mechanization on the farm are, Mr. Higgs suggests : standardization ; home production ; and the training of mechanics. "If we are to have improved and increased machinery, we shall have to give this matter of trained mechanics urgent attention," he said. "At the present time few farm workers can get technical education ; they go on a farm when they leave school and their only method of learning is by picking up bits from the oldest inhabitant, who very likely isn't too keen on these new-fangled ideas. I think the suggestion of a Farm Institute in every county is good, but it does not go far enough. I should like to see technical classes available within cycling distance of every farm worker."

Tyre Pressure A tractor drawing a plough has over half its weight thrown on the furrow wheels. The tyres on these wheels should, therefore, be pumped a little harder than those on the land side. When a tractor is used on the road, the front tyres should have a pressure of 28 lb. per sq. in. and the rear tyres 18 lb. The usual pressure for trailer tyres is 50 lb. per sq. in. The inflation should be checked by a tested gauge.

For field cultivation work the pressure can be somewhat lower—16 lb. for the front tyres and 12 lb. for the rear. This reduction often allows the driving wheels to obtain a better grip. Grip, however, can be improved by ballasting the wheels, and this is usually preferable to reducing the air pressure to an excessively low level. Iron weights attached to the wheels, or carried on the tractor platform, can be used as ballast ; or the driving wheels may be partly filled with water or an anti-freeze solution of calcium chloride. Ballasted tyres must be kept at a pressure sufficient to withstand the extra weight.

Tyres kept at the correct pressure have a longer life and, in view of the present rubber situation, it is essential that the maximum possible service should be obtained from all tyres on tractors and other farm vehicles.

Census of Agricultural Machinery, 1944 The Ministry of Agriculture and Fisheries is asking all occupiers of agricultural holdings in England and Wales to make a return showing the number of the principal items of farm machinery which they own on April 8, 1944. This information is essential for the proper planning of production and import programmes so as to ensure the best possible use of the limited supplies of labour and materials available for the manufacture of agricultural machinery and spare parts. The prompt completion and return of forms will greatly assist the Ministry in its planning for maximum food production.

Any occupier who does not receive a Census Form is asked to write for one to the Secretary, Ministry of Agriculture and Fisheries, Hotel Majestic, St. Annes-on-Sea, Lancs.

Crops and Stock At the end of 1943, the percentage acreage in this country of individual crops above that of the pre-war level was :

Cereals	80.0	Potatoes	91.6
Wheat	86.5	Vegetables	53.6
Oats	52 8		

Livestock population for the same period showed an increase of 6·4 per cent. in total cattle, but decreases of 21·6 per cent. in sheep, 59·3 per cent. in pigs and 38·6 per cent. in poultry.

NOTICES OF BOOKS

Green Hands. BARBARA WHITTON. Faber & Faber. 1943. *7s. 6d.*

Although this book is essentially a personal account of the farming novitiate of three land girls, in its broad aspect it may well be the story of every town girl who has donned the dun uniform of the Women's Land Army and found in the hard world of experience that farming is not the rustic idyll which it is often represented to be. For this very reason we shall do well to remember the debt we owe to these girls who have laboured to such good account and the majority of whom were totally unfamiliar with the endless toil which makes up the farming calendar.

The heroines of this book are Barbara (the author), Anne and Pauline ; and although Anne had reluctantly to give up, the others persevered to disprove the Scottish farmer's prophecy that they would in all probability "faint like cut grass". The aching muscles and feet just "lumps of frozen pain," as interminable rows of mangolds and sugar beet are lifted and "shawed" ; the innumerable heaps of muck that have to be spread over fields that seemingly stretch to eternity ; the apparently impossible job of hoeing turnips without eradicating the whole crop ; the glories and complexities of haymaking ; the breathless rush of corn harvest that has no place for the posturing Ruth of Hood's

imagining ; and the dust and grime of the threshing barn : all present their difficulties to the "green" but willing hands. In addition, Barbara had a milk round which called as much for diplomacy as it did for stamina.

But the recounting of such farm episodes would not of itself make this book outstanding. It is the background of good humour, as town and country get to know each other better, the smooth, natural style of the author and her undoubted gift for original metaphor which make it irresistibly entertaining and not a little instructive.

The Way of the Land. SIR GEORGE STAPLEDON. Faber & Faber. 1943. *12s. 6d.*

To-day, there must be very few farmers to whom the name Stapledon means nothing. Among the progressive elements of the industry the name has meant a great deal for many years : this new book will be welcomed by all those who like to know something of the great men of the day outside the limited channels in which their professional work runs, of the author's life and his own account of men and events which have influenced him. Here is no scientific hermit cloistered by the four walls of a laboratory or the four hedges around his trial plots :

> "All I have striven for, and all I have written or said, has been the outcome of simple and passionately held beliefs—beliefs which were borne of my early experiences and associations, and which have been greatly strengthened by influences resulting from a life devoted to practical purposes, and spent largely out-of-doors, and which has thrown me much in the company of simple people—those who do the real work of this rather unreal world."

That Sir George has always kept one foot firmly planted in the soil he loves so well accounts for the fact that to-day the high farming policy of at least one nation includes much of what he has been teaching and preaching for years.

There is rich wisdom and breadth of vision in his views on the ever-extending duties of a progressive state : "The prime care of the state," he says, "should be the health, the adequate material position, and the mental and spiritual development of the individual".

Sir George can be scathing when he feels strongly : "We in this country have neglected, misused and ill-treated our land surface to an outrageous extent . . ."

He little knew when he said this in 1937 how soon his lament would be echoing throughout the country, or how many of the specific evils that alarmed and depressed him would be the subject either of urgent war-time plans, or of reconstruction proposals.

His appreciation of the famous Scott Report should direct many new readers to that important document, among—in particular—those who normally fight shy of Blue Books.

The chapters which deal with present and future needs of rural Britain are fascinating if only because the passing of time has proved Sir George to have a knack for being right and of saying to-day what is an accepted truth to-morrow—or the day after. There is much here to stimulate the interest of all who attach value to the beauty and proper use of rural Britain and to the ever-growing insistence of its place in worthwhile national reconstruction proposals.

A comparison between the nation's position in the last war and in this will interest the younger generation and those with short memories. We are given a glimpse of an erstwhile Minister of Agriculture contemplating borrowing 60,000 horses from the Home Army to assist in the preparations for the harvest of 1918.

We see how Sir George's tenets of grassland improvement fit in with world influences and tendencies, whether good, as in the exchange of knowledge and experiences between countries, or evil, when a war shows up the weaknesses in a nation's economy.

Sir George Stapledon has a simple creed : the priceless gift of our fertile acres is our common inheritance ; to guard, preserve and use it as it should be used must be the prime concern of wise men and wise Governments.

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ARABLE FARMING AND CATTLE FEEDING IN THE LOTHIANS

IAN C. MENZIES

Liberton, Edinburgh

THE Lothians are well known as containing some of the finest arable farms in Scotland. The cropping basis practised on them varies according to their situation and altitude, in which there are great differences: similarly, rentals show considerable variation. At medium elevations, particularly in East Lothian, a six years' rotation is normal—potatoes–wheat–roots–barley–hay–oats.

Midlothian Four-Course Rotation Most farms on the lower ground, and particularly those near Edinburgh and neighbouring burghs to which this article mainly refers, are worked upon a four-course rotation—potatoes or turnips–wheat or barley (with grass seeds)–hay–oats. These are slightly varied in certain districts by having the two white crops in immediate succession, and making hay the last of the rotation.

While two successive white crops are open to objection, and are normally contrary to the terms of most leases, this system has some advantages. One, and perhaps the most important, of these is the opportunity provided to control charlock, the most persistent and troublesome weed to be found

in the area. It is not greatly evident in the wheat crop, probably because it germinates along with the wheat but fails to survive the winter. If the oat crop succeeds the wheat and is sown out for hay, the charlock seeds lie on the surface where, in due course, they germinate and die. On the other hand, if the stubble of the oat crop is ploughed the charlock seeds are buried, and so preserved to cause trouble later ; it is well known that they can lie dormant for many years. A well-known and highly respected farmer in the Edinburgh area, now of hallowed memory, attributed to this slight change of system his successful eradication of this abominable yellow weed from his farm. There is also the convenience of having the lea earlier and firmer than stubble for carting out the dung required for the succeeding rotation.

For the hay crop the seeding is generally upwards of 30 lb. of Italian ryegrass with 2 or 3 lb. of red clover. The proportion of the latter species in the crop is often small, owing to the competitive influence of the grass and the liberal use of nitrogenous fertilizer. It is quite usual to take a second crop of hay and to retain this for feeding purposes, while most of the first-crop hay is used for the farm horses or sold to stables, dairies, etc. This exhausts the ground to some extent and is contrary to the custom prevailing north of the Forth, where a much heavier proportion of clover is used, smaller nitrogenous top dressings are employed, and the aftermath following the first crop is used for "foggage".

Cattle to Supply the Dung This four-course farming necessitates a large supply of dung. In the case of suburban farms close to Edinburgh and other townships, the straw and hay used to be sold to dairies and stables of various types within or on the borders of the towns, and the dung was carted back to the farms. With the advent of motor vehicles and more stringent sanitary requirements, these stables and dairies have gradually disappeared, and the farmers concerned have had to feed cattle to consume their produce and make their dung in the same way as their brethren whose farms are farther afield. This, in many instances, is not an easy matter, as the steadings, built probably over 100 years ago for purely suburban farming, do not contain sufficient courts or other accommodation for the requisite number of cattle.

To combat this difficulty, and for other reasons, many farmers contrived to lengthen their feeding season ; some to the extent of fattening two lots of cattle, and others by buying in leaner sorts requiring longer keep. When there were ample supplies of linseed, cotton and nut cakes, maize and other imported foods, the cattle could be fattened quickly and they produced dung of higher quality that went further. Despite the very considerable outlay involved, it was not unusual to find farmers giving their fattening bullocks these imported feedingstuffs mixed with dried grains and other light concentrates in quantities starting with 4 lb. and gradually increasing to about 14 lb. per day.

Before the heavy feeding of concentrates was practised, it was usual for farmers to feed turnips to their cattle at the rate of about 100 lb. each per day. There is an East Lothian adage that one can fatten cattle "on turnips in time". But, with the advent of the pre-war method, the daily ration of turnips was reduced to about 40–50 lb. It was found

possible to fatten bullocks in 13 or 14 weeks, with the result that two lots to the season were possible.. The beasts were turned out with a finish satisfactory for killing without, however, a large increase in size and weight.

Changed Methods under War-time Conditions War-time restriction on imports and the consequent severe rationing of feedingstuffs of both home and foreign origin have completely changed the outlook, and farmers have had to alter their methods. Many have secured results beyond their expectations and are being prompted by their Scottish instincts to grudge the large outlays they used to incur for imported cakes and wonder whether the expenditure was justified. One drawback of the present system is that the feeding period is extended by six weeks to two months. It is thus difficult, if not impossible, to fatten two lots of cattle, and most farmers have perforce to keep only one lot throughout the house-feeding season, with the probable result of marketing the cattle somewhat larger and heavier than they would otherwise have been.

Adjusting Feeding to Earlier Housing of Cattle Experience has shown that the first, and probably the most important, change of practice is earlier housing of the cattle. Formerly, few farmers housed their beasts before November. After September some of the condition and freshness they gained on the grass was lost. The animals were difficult to start, and a considerable time was spent in regaining the lost condition. To do so entailed the expenditure of a considerable quantity of feedingstuffs without any gain in weight. In recent years many successful feeders have brought in their cattle off the grass about September or early October.

For the first two months or so, they merely need straw and turnips to maintain a steady though slight improvement in their already fairly good condition, and it is only during the later feeding period of say four months that more expensive feeding has to be provided. This is normally started by providing hay for the evening feed, while the animals are still having all the straw they can consume during the day. The hay ration is gradually increased. Cereal and protein foods are then given upon a gradually increasing scale, so far as supplies will permit. Present regulations make it practically impossible to provide anything in quantity except oats. As opportunity offers, hashed oats are mixed with the few cereals and proteins for which coupons can be obtained. A useful addition is sugar-beet pulp. As most Lothian farmers are directed by the War Agricultural Executive Committees to grow sugar beet, they qualify for at least a small allocation of pulp, which few decline the opportunity of acquiring.

Value of Second-Crop Hay Practice has changed as regards the utilization of hay. For the past two or three seasons there has been a demand by sheep farmers and others in both the West and the South for second-crop hay, and consequently it has been making a price little short of the controlled maximum price available for first-crop hay. With this excellent market for their second crop, farmers have had no real inducement to sell their first-crop hay, so they have largely used it for fattening bullocks, with excellent results. It has

been found that good well-harvested first-crop hay is hard to beat for feeding purposes. To get the best out of the hay for cattle feeding, it must be cut earlier than formerly was the custom and secured as speedily as possible, so as to preserve its greenness and high protein value with a minimum of loss in the making.

As regards turnips, there has been a reversion towards the former practice of giving a large supply, and the quantity now provided daily is probably 80 lb. or thereabouts. This has the effect of producing more urine; consequently a larger quantity of straw is required, resulting in an increase in the quantity (though not the quality) of dung.

High Prices Paid for Store Cattle In view of the cost of feeding, no arable farmer can hope to get from fattening cattle any other return than dung. In fact, it is truly said that every bullock dies in debt.

The first and main contributing factor is the high price which is being paid for store cattle, both home-bred and imported. One would naturally favour home-bred stock, since experience has shown that they eat less and fatten quicker than imported animals, besides being more pleasing to look at. Unfortunately this is not practicable. In the first place the supply is very limited, consisting largely of suckled calves sold at the October sales. These auctions produce prices very satisfactory to the breeders but having no relation whatsoever to the value of fat animals consigned to the Ministry of Food under the present grading system. The highest price available for fat home-bred cattle at that time of year is about 70s. per cwt. and the highest possible (in June) 80s. 6d. per cwt., but the price which has to be paid at these sales is often in the region of 90s. to 100s. per cwt. In any event, these beasts will not make heavy weights, which are required for disposing of a maximum amount of straw, and they will not bring in an appropriate figure when graded, for the Ministry's scheme of prices gives no recognition of the handiness of the joints or quality of the beef produced.

Irish bullocks, on the other hand, are normally in fair supply and can be bought much older, stronger and heavier than home-breds. They trample in more straw and are likely to bring proportionately better prices when marketed. They are fairly certain to show a greater increase in actual weight than home-breds. It must always be remembered that fat Irish cattle consume more food and eventually fetch 5s. less per cwt. than home-breds.

Irish Stores But Irish stores are not easy to buy. They are brought to Edinburgh and other markets by Irish dealers, of whom most are good judges of cattle and all are clever salesmen: indeed, there are few other businesses in which expert salesmanship is so generally marked.

Store cattle are seldom sold by weight. As a rule, the farmer's eye has to be his merchant. The Irishman usually tells his tale of what will be the outgoing weight of the bullock at the appropriate date. In this, he is always a supreme optimist. He never by any chance has a beast that, in his estimation, will not secure the highest grade possible at time of sale! In the normal buying months (September to November) the price of fat

Irish cattle is around 65s. The highest possible grading price (in June) is 75s. 6d. Farmers often pay up to 80s. per cwt. on the actual buying-in weight, which is seldom, if ever, known to them until after the bargain is made. This occurs at auction as well as private sales. It is safe to say that no Irish stores have been sold during the past season or two at prices which were not anything from 5s. to 15s. per cwt. above the current fat price. While the latter figure may be exceptional, many must have been on or about the 10s. mark where really good stores were concerned.

Price and the Question of Beef to Live Weight From the home-breeders' point of view, it must be rather distressing to see so many heavy, sometimes coarse, Irish bullocks being awarded the special grade. Graders, however, are powerless to do otherwise, as they have only one criterion upon which to work, namely the percentage of beef to live weight. The bigger and heavier the beast the larger is the proportion of bone to be included in the carcass weight. If the latter is estimated to be 58 per cent. or more of the live weight, special grade must be awarded. Many prime animals will produce upwards of 60 per cent., but no extra or super-grade is available. This is a definite hardship which ought to be remedied, unless it be that a higher or super-special grade might encourage the production of over-fat animals. In consequence of the lighter weight of most home-bred cattle as compared with imported, they have a smaller proportion of bone and consequently suffer in their grading as regards actual beef content.

In this way much of the advantage of the home-bred price is lost. The bullock most likely to bring the best return available under the Ministry of Food's present price system is a well-grown Irish beast of 11 cwt. or more. Each animal may have been the means of creating 7 or 8 tons of dung over the period.

In consequence of the present position, and the fact that there is a large surplus of barley straw for disposal, it is not surprising to find that a fair number of farmers in the Lothians are experimenting with other ways of rotting down their straw, such as composting with ground limestone, sulphate of ammonia and water.

HAYMAKING

CLYDE HIGGS

Hatton Rock, Stratford-on-Avon

WRITING this article in cold blood, with the thermometer near freezing point and a north-east wind blowing, is a simple job compared with piloting the produce of a small field from good grass to good hay in flaming June. Haymaking is an art, and in no other farming operation do our best laid schemes so often go awry. Expert opinions have differed and always will differ on the methods which give the best results, although the usually accepted necessities for good hay are hot, steady sunshine, first-class material, willing workers, and adequate machinery. The sunshine is in the hands of Providence, but in my part of the country early June usually provides the most settled weather.

Danger of "Too Little and Too Late" Generally I find that seven to ten days before I think the crop is ready is usually the best time to cut. Even with a small acreage it is evident that the whole crop cannot be gathered at just the right moment. An early start, therefore, must increase the amount of high-quality material. In any case, the variation in the analyses of hay is very wide, but hay from young leys is far more valuable than that from old grass. Sometimes this hay is criticized on the score of coarseness; actually, it is a criticism of the farmer, since he failed to appreciate that this grass is ready for use much earlier than that from the old sward. Most of my grass is in two-year leys, and the mixture is varied so that in a difficult year, such as 1943, when I lost a lot of my young seeds owing to drought, it will stand for a third year.

I must admit that my seeds mixture is something of a dual-purpose one. I have yet to get to the stage where I can put a certain mixture on a field and use it for a definite purpose. If I could arrange things mathematically on my farm I should always graze for the first year then cut for hay the second. Complications arise which prevent this, but I think it is hard on young seeds to cut them for hay in their first season. No matter how heavily they are grazed, the effect is not the same as using a mowing machine. I dress all my grassland with nitrogen early in the year, and as soon as there is a cut we make silage. When the grass gets beyond the young leafy stage we start on hay.

Immediately the crop is gathered, another dressing of nitrogen is given and then an autumn cut taken for silage. A field of grass will produce only a certain amount in the season, and one is more likely to get the maximum by cutting an early crop of hay and then top-dressing for the aftermath than by leaving the hay for a maximum crop in the first place. No other farm crop suffers so much from "too little and too late".

Machinery in Haymaking There are many ways of making hay, and I have tried most of them. I do not think there can be any difference of opinion that cocking or piking is the best method, but it is comparatively slow and expensive. The tripod method is an improvement on this, but is subject to the same defects. In any case, both these methods are limited to small acreages. For the average farm more machinery is necessary, so that at least two days work can be got into one.

Let us consider the operation from the beginning. From the horse-mower, with which my grand old wagoner and a pair of horses could do all the cutting between sunrise and carrying time, I graduated to the tractor-drawn horse machines which soon rattled to bits, then twin tractor machines looking very massive but not proving too efficient, and so to a 6-ft. American-made trailer mower, which lifts and stops the knife automatically at the corner. I have had experience of machines attached to the centre of the tractor. In my opinion this is the proper way to do it, but there does not seem to have been sufficient care in design; or is it that the tractors are driven too quickly? Mowing machines reasonably used are, on the whole, very reliable, the most usual complaint being that the knife does not centre properly; it is well worth testing this adjustment frequently. A sharp knife is absolutely essential; and I wish, incidentally, that I could find a machine for keeping them sharp. I had one once, but the men soon reverted to sharpening the knife in the ordinary way with a file.

As maximum evaporation is necessary, it is obviously good practice to move the grass as soon as possible after cutting, so that the air can get through it ; in some cases machines are fitted to the mower for this purpose. There is a tendency on many farms to leave the grass to bake thoroughly on one side, and then when nearly every vestige of food value has disappeared, to turn it over and do the same with the other side. The resultant product is of much less value than poor oat straw. During the process of making, the grass must be handled tenderly to preserve the leaf as much as possible. Some types of turning machinery are none too gentle. A few years ago I was fortunate enough to obtain a set of three very old-fashioned kickers. Made in France, they imitate exactly the action of an ordinary hay fork and can easily be pulled by a light tractor. They will turn about 8 to 10 acres an hour and are invaluable in a "catchy" season.

Sweeping For those who like to do their carting to a rick-yard in the summer, regardless of the loss of valuable hours, trailers and loaders will be the carrying implements, but the vast majority of farmers prefer to make the rick in the field and cart it away at leisure. I first rake the crop into as heavy rows as possible with a tractor rake. If you are not fortunate enough to possess a tractor rake, do not hitch to your tractor an implement which was intended for an old horse. There is no alternative method of carrying hay in the field to that of sweeping, be it by horse, motor car or tractor. Horses are too slow, old motor cars too temperamental, and tractors too valuable for such a job, but of the three I prefer tractors. In the good old days my tractors were always traded for new ones at the end of haymaking—it was the last straw. I use the type of sweep which is carried on the rear wheels of the tractor, and the height of the points can be adjusted. It is an excellent job and we break very few tines.

A still quicker way is to use an American stacker. A sweep load is driven on to this implement, which looks like a sweep on two high supports, while it is lying on the ground. A small engine elevates the whole lot on to the rick, but it takes an exceptionally good man to build a rick and considerable work is entailed in sorting out the big loads.

Good Foundation to the Rick There seems to be no real reason why hayricks are built in the middle of fields; they take more fencing, and if by any chance one should be fortunate enough to save a rick, its position is very inconvenient.

The size of the rick provides some points for discussion. The efforts of some farmers who are apparently optimistic as to yields, look more like "dumps" than ricks. There is no finer sight on a farm than a well-built hayrick, and it is impossible to get this if the bottom is too large. Rick builders are men of few words and strong opinions ; and it is best to keep out of the way until the rick is well started. Only when it is finished do you presume to mention what a pity it is that you were not there at the time ; then it would not have been so big or so small, as the case may be ! With hay at its present price, it is well worth using a good foundation of wheat straw, baled if possible. I cannot build a hayrick myself ; equally I cannot lay an egg, although I am a good judge of an omelette. But my advice to those who can build hayricks is to keep the middle up ; it is surprising to find how many builders ignore that elementary fact.

I have the low hopper type elevator, a long-suffering, ill-used piece of machinery, particularly the small engine that drives it. We had a serious fire last year simply because the protecting board on the engine was not

in position and a wisp of hay ignited from the exhaust pipe. I think haymaking is an occasion when smoking should be prohibited without exception.

My usual team is one tractor sweep, one tractor rake, two men at the foot of the elevator and three men on the rick. Considering how heavy is the physical work of haymaking, it is surprising to find that the men are usually keen and work very well. The Daylight Saving Act is a severe handicap, for even the most willing workers in the world cannot start with the clock in the morning and finish with the sun at night.

Baling I have had some experience of baled haymaking, using stationary balers and sweeps. The approximate output for each baler is about two tons an hour, but it is a slow process compared with ricking by elevator, and the finished article tends to have a dead smell instead of the rich scent of well-made hay from the rick. A pick-up baler is a useful accessory for odd, isolated fields. In choosing the sites for my ricks, I have to bear in mind that they will most likely be used by a milking bail. If they are needed for young stock we bale them with a stationary baler.

Thatch Immediately There is apt to be some disappointment in comparing one's own hayricks with those of other farmers, particularly when the other man has put a good top on them. The explanation in many cases is the difference in methods. A slow method of carrying ensures a more even settling of the rick, and consequently a fine top can be put on it. With the sweep-and-elevator method, the tackle is usually moved into another field before the rick has had time to start settling, and the simple solution is a good load of straw as a top. I have often been warned about the need of letting the rick settle properly before starting to thatch. It is a silly tale; the time to start thatching is immediately the rick is built, and I am convinced that a large amount of good hay is wasted through waiting for the "proper" time—in any case, the loss in the rick is 15–20 per cent., which is quite enough without adding to it.

Salt if Necessary In my part of the country we have, of recent years, had three exceptionally easy hay harvests, but should weather conditions be more difficult this year, I think that the use of 15 lb. of salt per ton sprinkled on the hay when building the rick is a better method than carrying damp material and then having the whole lot go up in flames. Some years ago I cut a field in which were a lot of dandelions, and five weeks later the rick burst into flames, although a number of holes were cut in it. The alternative is to turn the hay in the rick—a monotonous job, and I do not think that turned hay ever equals the real stuff.

Looking round my farms to-day, I see one or two hayricks left from last year, and I know of no better sight to brighten the landscape.

COMBINE HARVESTING

THE purchase of a combine is only the beginning. Before the order is placed, thought must be given to such questions as how the machine is to be hauled; to the facilities for carting grain from the field and for drying and storage; to the method of handling loose straw in the field, and to the ability of the farm staff to work the machine. The farmer must ask himself: are the tractors available on the farm powerful enough?—is a power take-off required and, if so, is that of an existing tractor suitable?—is there sufficient tractor power on the farm so that the necessary machine can be spared for combine harvesting?—are there adequate repair facilities in the neighbourhood?—are the gates and roads wide enough to enable the combine to pass from field to field?—is the land too steep or do branches overhang the fields, so that the combine could not work close to the hedges?—is the farm staff large enough, so that if a binder has to be worked as well as a combine the men may be divided between the two forms of harvesting and retain their full efficiency?—can a sufficient supply of sacks be provided?—are there lorries available to bring the grain in from the fields? There are many other questions which will arise from the circumstances on individual farms. In general, combine harvesting is like harvesting with binders; to be successful it requires a planned organization, but the problems to be considered are different.

Factors Influencing Efficiency The efficiency of combine harvesting is influenced by many factors, the chief amongst which are the variety of cereal, the volume of straw, uniformity of ripening, the cleanness of the crop, the moisture content of grain and straw (which is in turn influenced by the weather and even the time of day when the cutting takes place), the way the crop stands, the efficiency of seedbed preparation, the length of the harvest season, and the ripeness of the grain at harvest. Uniformity of ripening is controlled by a number of factors, but two of the more important which are often overlooked are the variation in soil type in a particular field, and unevenness in the depth of sowing.

The requirements of a combine that the grain should be dead ripe and dry are not always present at the normal English harvest and, consequently, there may be loss of time waiting for them. It is therefore a mistake, particularly in areas of high rainfall, to rely entirely on combine harvesting.

Crops for Combine Harvest Most crops can be harvested by combine but they vary in difficulty. The easiest crops to harvest are the cereals—wheat, barley, oats and rye, in that order. There is often some difficulty with oats, in that most varieties when dead ripe are subject to shedding, and the straw often becomes brittle with the result that a crop may be laid. Some farmers overcome this difficulty where the oats and the straw are required for stock-feeding by combining oats in a slightly less ripe condition than is chosen for the other forms of grain. They claim that by doing so they get excellent feeding oat straw and have no difficulty with the grain. Alternatively, a good job can be done when the oats are dead ripe, provided the machine is carefully set and driven slowly. This is especially true when the crop is heavy.

Beans can be combined direct, but peas are best cut into a windrow and later gathered by a pick-up attachment. Other crops, like mustard seed, sainfoin, clover seed, linseed and rape seed, are best windrowed and allowed to dry and ripen completely before being picked up and combined. The inexperienced user of a combine should begin with the less difficult crops and proceed to those which require greater skill in handling.

Harvest Period and Cereal Varieties If the maximum use is to be obtained from a combine the machine must start early in the season, using the windrow and pick-up method, and then following with direct combining as the harvest allows. It follows that if this method is to be adopted all combines should be fitted with a pick-up attachment. The period over which combine harvesting is possible can be lengthened by arranging crops and varieties of crops to mature at different times. Oats, barley and wheat, in that order, roughly spread the harvest period. It can also be lengthened by a suitable sequence of sowing dates and by choice of varieties. A cereal variety for combine harvesting should be fairly short strawed, ripen uniformly and stand without shedding for some time after maturity. It cannot be emphasized too often that grain should be as nearly dead ripe as possible before it is combined, and that this means 10 days or so after the time when it would usually be ready for the binder. In selecting varieties, the simplification of combine harvesting should not be allowed to encourage the use of inferior varieties nor the multiplication of varieties, so that a really good bulk sample cannot be produced. In some cases there may be justification for choosing an earlier-ripening variety to get the harvest started. Kenia or Marja may be used to fit in with Spratt-Archer or Plumage-Archer, or they might be used instead of Spratt- or Plumage-Archer where the type of barley is less important than the necessity for getting it out of the way before the wheat is ready. In the same way the wheat harvest may be lengthened by using early- and late-maturing varieties. In selecting the varieties of cereals to be grown, the leaflets of the National Institute of Agricultural Botany should be consulted, but it must be stressed that where the harvest can be carried through without the use of a number of varieties, the resulting bulk sample will be more suitable for milling or malting.

Estimating Output In estimating the output from the combine, the beginner is strongly advised to rely only on a low figure until he has gained experience. The seasonal capacity of the machine is usually taken at 25–30 acres per foot width of cutter-bar. An 8-ft. cut (a convenient width for most farmers) will normally harvest 200–240 acres. A more accurate estimate would be that based on the output of sacks of grain, and not on the acres per foot of cutter-bar; but such an estimate can be made only after experience, the output being largely governed by the weight of straw, and not only by the grain. In late districts the daily output of the combine harvester is naturally reduced by the shorter working day, and an allowance should be made for this.

Again, there are many factors which slow down the output, such as rapidly growing weeds, storms and unevenly ripened thin crops of wheat or barley. One or two harvests with a combine which have been easy may mislead the farmer into believing that the output of the machine on his land is much greater than it actually is. The next harvest may be bad, and if he has over-estimated the output of his machine he may find himself in serious difficulties. A safe plan, therefore, is always to work on a low estimate.

The Grain Bulk handling of grain is more economical of labour than bagging, but a farmer must be certain of his facilities for hauling, drying and storing in bulk before this method is adopted. On scattered holdings, or on those without a drier, handling in sacks is generally more convenient, since it makes temporary storage easier. Sacks which have to be left in the field should stand on dry straw, one sack deep only, with the mouths open, and should be uncovered by day during dry weather.

Sacks in barns should not be more than two deep; again their mouths should be open, and they should be so spaced that the air can circulate freely. The method of handling grain on any particular farm is a major problem which should be considered most carefully in planning harvesting by combine.

Reduction of Moisture Content The drier the grain when it is harvested the less subsequent treatment will be needed. To this end the moisture content should be kept as low as possible. This can be done by first leaving the grain until it is dead ripe, then by watching the weather, by timing the starting and finishing of combining each day, and by so adjusting the height of cut that green growth, whether of weeds or undersown crops, does not interfere with the grain. The moisture content may thus be kept low by cutting high and by using the combine only on the cleanest and best standing crops, leaving the rest to be cut with the binder. This combination may be difficult to work where there is only one harvest team, but it is relatively easy on farms where two harvest teams are necessary. The binder can often operate early and late when the corn is not sufficiently dry for combining.

Since the binder starts earlier in the season than the combine, care must be taken where both are used not to select fields for harvesting by binder which later will be specially suited to the combine. Large open fields are, of course, best for the combine, but where trees overhang fields otherwise suitable, the shaded portions can be cut with a binder and stooked when the rest of the crop is ready to combine. Crops of ripe oats or barley which are laid can be harvested by a combine with less waste than by ordinary methods using a self-binder. Very weedy crops which might give trouble with the older method of harvest can often be satisfactorily harvested by windrowing and threshing with a combine fitted with a pick-up attachment. As the farmer gains experience with his combine, he will take these and other factors into consideration before starting his harvesting.

In all districts there is a serious risk involved in using a combine without making arrangements for grain drying, but in the wetter areas it is impossible to harvest by combine without a drier. In areas of moderate rainfall, say below 30 in., it is possible to manage without a drier, but great skill is needed in judging both crop and weather, and in organizing the work of the combine and self-binder teams so that no damp or unripe corn finds its way into store. A power winnowing machine is helpful where a drier is not available, so that any green material may be separated from the grain within 24 hours.

The ideal arrangement is to have a drier on the farm where the acreage of grain warrants the capital expense, but failing this plans should be made in advance to use either a neighbour's drier or one belonging to a merchant. In some districts it may also be possible to send the grain to one of the newly constructed national silos which have a drying plant attached.

Take the Straw Off Early Where it is proposed to take the straw off the field for litter or other purposes, it is advisable that this should be done as soon as possible after combining, since the straw quickly deteriorates if it is left lying in rows in the field. There are two satisfactory methods of doing this. One involves the use of the pick-up baler, by means of which the straw can be baled immediately following the combine and the bales carted away to be stacked. The second method is that of sweeping the straw to an elevator and stacking it direct on the field. There is little to choose between these two methods

in so far as the time taken for the operation is concerned, but the former makes a neater job. It is, however, rather more expensive than the sweep-and-elevator method.

If, on the other hand, the straw is to be ploughed in, a spreader should be used, but on windy days it may be impossible to prevent the straw blowing about and becoming entangled with the growing crop. This difficulty can be overcome if the combine is provided with a chaffing fitment which can be used in conjunction with the spreader.

The ploughing in of straw presents problems, not least on light, thin, chalk soils, and it is important that the conditions should be carefully studied in each case. Combine users will probably be well advised in most cases to seek advice as to the best means of getting the straw properly incorporated in the soil.

TRACTORS ON SMALL FARMS

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BY "small farm" is meant any one of the everyday mixed farms of not more than, say, 150 acres which together make up about three-quarters of British agriculture. Such a farm will ordinarily be worked with not more than four or five horses; that is to say, it will have managed until now with rather less than the power of a medium-powered tractor. But this does not mean that when it gets a tractor it will be able to dispense with all the horses: for hardly any farm—and certainly not a small mixed farm with its variety of overlapping jobs—can, in fact, manage with one tractor unaided. Sooner or later occasions will arise when it is impossible to carry on with all the available power "under one bonnet"; and, if only to meet these occasions, two at least of the horses will have to be retained.

Tractors and Horses should be a Team Now all this may seem very obvious, and in all probability our imaginary small farmer would not think of getting rid of all his horses when he buys a tractor. Yet all too often farmers in this position fail to regard their tractor and remaining horses as a team which ought to be organized with the work apportioned and equipment provided, so as to make the best use of each. Perhaps the commonest mistake is simply to buy a tractor with no particular equipment to go with it, in the vague hope that the extra power will come in useful on occasions. This leads to the kind of thing which the writer has seen going on more than once during the last few months: a small farmer's horses doing the ploughing and drilling while his tractor trifles around with a set of light harrows—simply because they were the easiest things to tie on to the tractor at the last moment.

On the other hand, the results of going to the opposite extreme, and imagining that because one has bought a tractor it ought to be used on every possible occasion, are sometimes equally ridiculous. Last year, very comprehensive "small farm" tests were carried out on a number of different tractors, and among the jobs to be done was root-hoeing. First of all, the tractors which had previously been engaged on preliminary cultivations, drilling, and so on, had to be fitted with equipment for the job. So, in the

most typical case, the tractor driver, with at least one helper, spent the best part of a day fitting a sort of bustle (consisting of anything up to half a ton of assorted ironmongery) round the tractor, adjusting the wheels to the appropriate row-widths, setting hoe stems, and so on. Then the tractors went into the field, and with quite reasonable success, hoed four or five rows of beet. The best work was done by steerage outfits, needing two men and working at a speed of rather less than 2 m.p.h. But in the next field, on the same farm, a horse with two men and an ordinary steerage horse-hoe was also hoeing five rows of beet at just about the same speed ; and it had done five or six acres by the time the average tractor was fitted with its bustle. Moreover, it was obvious that the work done by the horse was rather better than that done by any of the tractors ; while even leaving out of account the time spent in fitting equipment on the tractor—and the time to be spent later in removing and putting away some or all of it—the cost per acre of the tractor work must have been nearly double that done by the horses.

Special Circumstances of the Small Farm In the writer's view, mistakes like these would be avoided if three or four general considerations were kept in mind from the start.

First, the small mixed farmer's approach to mechanization must necessarily be quite different from that of the large farmer. On large farms which can aim at the complete elimination of horses, the use of tractors in almost any circumstances can be justified because in the process of mechanization the regular labour complement will have been reduced by two-thirds or more. But sweeping changes of this sort are impossible on the small mixed farm which has only three or four men to start with, and which will always need nearly as many to meet the needs of its livestock side.

Secondly, in the circumstances the tractor's most important function is to put the farmer "on top of his job". It ought, therefore, to be chosen and equipped with special reference to the operations in which the small farm most commonly gets behind with its work ; in which failure to get finished at the right time will involve risk of poor or damaged crops ; and in which, therefore, greater power and speed of working can be used to the best advantage.

Thirdly, if properly looked after a tractor will not wear out, and costs practically nothing when it is not working ; although it will cost nearly as much to run about a field doing nothing as when developing full power. Horses, on the other hand, grow old and need to be fed and cared for even if they stand idle.

In terms of actual £ s. d., the last point can be put roughly as follows at the present time. Reckoning the life of an average tractor as, say, 750 working days, it would cost something like 42s. per day to work with a full load, 36s. to run about with no load, and only 1s. per day (for interest and rent of shed) to stand idle. A pair-horse team will cost something over 20s. per day to work, and 8s. per day (for food, depreciation and general maintenance) to stand idle.

The conclusions to be drawn from these remarks will obviously depend to some extent on the actual farm concerned. Most farmers will agree that ploughing and drilling are among the jobs in which the tractor's ability to get things done in time ought to be realized to the full ; and most of them, quite logically, would want to use it for the heavier cultivations as well. According to circumstances, various other jobs, like mowing, binding, sweeping and potato ridging, might be included, although more often these

would be open to argument. In any case, the justification ought always to be either that the job in question genuinely needs to be done more quickly than the horses can manage it; or that the horses will be wanted elsewhere at the time; or that money will be saved by using the tractor.

When is a Tractor Justified? So far nothing has been said about the kind of tractor we have in mind, nor the acreage which will be necessary to justify its use. The first requirement of the tractor—as, indeed, of any other piece of equipment for the small farm—is that it shall be robust and reliable; the second is, probably, that it shall be cheap. There will be quite enough to contend with at the introduction of mechanization without trying out experimental models; while the money laid out on extra refinements will probably be spent better in saving labour in and around the barnyard. As a purely personal opinion, the writer would add that the small-farm tractor ought not itself to be too small—that if it cannot plough about four acres in the time that a pair of horses would plough one on the same land, it will scarcely be worth having at all. As to size of farm, the writer's opinion is that the purchase of tractor, plough and drill would be justifiable whenever the saving arising from their use would exceed the interest on their cost. Suppose that the three together will cost £300; that tractor drilling will be no cheaper than horse work; and that interest is reckoned at 5 per cent. We then have to earn £15 a year by a saving on ploughing costs which ought to amount to 8s. or so per acre: 40 acres under the plough would be enough.

Equipment

2–3 Furrow Plough To return to equipment, the first obvious item is a two–three furrow plough. This does not mean *either* a two-furrow or a three-furrow plough, but a genuine three-furrow which can be adapted to two when absolutely necessary, but which should be reverted to three at the very first opportunity. Bearing in mind that the final objective is a seedbed—not just rows of prettily set-up furrows—ploughs ought, in most cases, to have semi-digger, rather than general-purpose, bodies.

Ancillary Implements Next comes the implement for the heavier cultivations. This may be either a straightforward cultivator, a disc harrow, a spring-tined cultivator, or even one of the special forms of heavy harrow. Here the choice must obviously depend on soil and circumstances, with the reservation that small farms want general utility, not special purpose, implements. In most cases, the likeliest choice will be the ordinary cultivator, and the only question to be decided will be its size. If it has two more tines than the farmer thinks enough for the tractor, it will probably be just right for economical working; while when the going is hard, the outside legs can easily be taken off. One thing which may affect this choice is that once a farmer gets accustomed to his tractor and three-furrow plough, he will probably remember the cross-ploughing which he or his predecessor used to do, but for which there has probably been no time to spare recently.

Tractor Drill Then last, but not least, among the tractor implements which every tractor-owner ought to possess is the drill. It must definitely be a tractor drill, and preferably one made by a firm experienced in making tractor implements; it should be adaptable to root drilling (subject to being matched-up with the horse-hoe) and it ought to be as wide as can be managed with the existing gateways. It will nearly always be too narrow for the tractor, so that the harrows ought to be attached behind. The present article is hardly appropriate for a discussion of the

merits of combined seed and fertilizer drills, and one assumes that, for the time being at any rate, the horse and existing distributor will apply the artificials fast enough.

Binding—A Compromise Now if the above modest list covers all that the writer thinks absolutely necessary, there is at least one other operation—binding—which nearly every farmer will want to include. But a tractor-binder is a rather expensive piece of equipment, while if a horse machine is bumped around at high speed it will not last very long. Perhaps the right compromise will be to rig up the horse machine for tractor draught, but there should be insistence on a moderate speed of working. After all, even a slow-moving tractor will have a decided advantage over horses in jobs like binding and mowing, simply because it will be able to keep on working through meal-times and on into the evening. But if the acreage to be cut makes it essential to work at high speed, a proper tractor implement should be bought in the first place. Otherwise the farmer will find himself having to buy one in the long run, with only a pile of scrap to trade against it.

JAPAN'S AGRICULTURE

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AGRICULTURE has been described as the fifth front of each warring country in the present global strife. There is much natural curiosity about Japanese agriculture, but knowledge of it in the West is rather vague.

Only One-sixth of Land Area Cultivable Japan proper consists of several hundreds of islands, of which Hokkaidô, Honshu, Shikoku and Kiú-shû are the largest. They lie in the western part of the North Pacific Ocean, extending from 50°N.—the northern limit of Sakhalin—to nearly 30°N. (This corresponds to a range of latitude from Lands End in England to the southern shores of the Mediterranean.) The country is very mountainous and signs of volcanic activity are everywhere evident—active volcanoes, extinct volcanoes, ancient craters, etc. There are many hot springs, and earthquakes, landslides and tidal waves occur frequently. The climate differs markedly from that in corresponding latitudes in the western hemisphere. In summer the heat is almost violent in comparison, and in winter snow, frost and cold are very severe in the northern sections. There is no counterpart of the Gulf Stream, with its mitigating effect on the climate of Britain and Western Europe. On the eastern side a warm current from the South is pushed away from the land by cold currents from the North.

By reason of its mountainous nature, not more than one-sixth of the land surface is available for cultivation. There are a few large pastures or ranches for cattle and horses—particularly military horses; sheep, although the object of much official encouragement, are represented by a very few flocks; pigs are the only common domestic animals found in considerable numbers.

Small Holdings and Primitive Methods Generally speaking, the arable lands are subdivided into extremely small holdings — the average is less than 2½ acres per family in the main islands ; even in Hokkaidô, the northern island, the average area per family is only 7½ acres. Both the methods of cultivation and the implements used are primitive. The so-called plough commonly used differs little from that employed in Egypt during the times of the Pharaohs. Hoes, spades, harrows, sickles, flails, all call for hand labour. Even the homely wheelbarrow finds no place on a Japanese farm. (In China, the wheelbarrow is used extensively for road transport, as well as for the more usual purposes.)

Rice the Staple Food Crop Rice under irrigation is the staple farm crop, and not far short of 60 per cent. of the whole arable area is under this cereal. It is true that much of the land produces two or three crops a year, but only one of these is irrigated rice. This crop is sown in seedbeds in April and transplanted to the fields by hand in June-July. Harvest extends from late September to November, according to the district. In a very good year, with the addition of the Korean surplus rice, Japan may get within sight of meeting the home demand for rice, but the actual growers of rice seldom taste it, except perhaps on one or two very special occasions in a year. The farming and lower grades subsist on other grains—millet, barley and beans.

Yields from the rice fields are high despite the somewhat primitive methods which mark some stages of production. The average for the whole country is put at over 40 bus. per acre in a good year, down to 30 bus. per acre in a less favourable season. In the warmer southern districts yields of 80 bus. or more per acre are not unknown, while in the colder northern areas an almost total crop failure is invariably recorded once every few years.

LITTLE ECONOMIC BENEFIT TO THE RICE-GROWER The price of rice to consumers fluctuates a good deal, and to obviate this the Government intervenes by buying home-grown rice when the price falls and exercising some control over the import of foreign rice. This State intervention does not work out very well in practice, and the rice-producer benefits little, if at all. The burdens of national and provincial taxation fall more heavily on agricultural land than on industry and commerce, which have greater political power and so can out-vote or outwit the peasant-tenants or small owners : the result is much agrarian discontent. The costs of rice production in Japan are always given as greater than the returns, so that there is a constant rise in agricultural indebtedness to banks and moneylenders.

Japan's economic position in regard to rice is not happy. The fortunes of the war have put into her possession or control all the countries in south Asia from which imported rice came to the island empire, whilst the market in India and other countries is closed to her. Even leaving out Burma from the calculation, Japan now controls almost 49 per cent. of the world's rice crop. This is far more than she needs for her own requirements, although a change in fiscal policy might largely increase the numbers of rice-eaters in Japan ; it is the high cost of home-grown rice that places it out of the reach of a large part of her population.

Silkworm Culture Next to rice, silk cocoons are the most important agricultural product in Japan. In the past half-century Japan has climbed to the top position in world production of raw silk. Before the war this commodity constituted her largest single export

and accounted for nearly 80 per cent. of the world's total silk supply. Of this, 80–90 per cent. found its market in the United States, and the rest in Europe (including Britain), Canada and Australia. China, although the original home of the silk industry, has fallen far below Japan as an exporter of raw silk.

The technique of sericulture is well adapted to the native genius of the rural dwellers, and mulberry-growing is well understood. Over 70 varieties are officially encouraged, each of which has its own special characteristics. There is available a supply of leaves to feed the spring-hatched worms as well as the summer and autumn rearings.

On the silkworm side, the most detailed and efficient supervision of egg-laying moths, eggs, egg cards, etc., to detect diseases and defects, is rigidly carried out by every known modern method, and there are many national provisions for education in the silk industry. Three institutions of college grade, 16 to 20 of middle school grade, experimental stations in every silk area, county lecturers and experts, all combine to promote this one industry. Further, there are many privately supported institutes for the dissemination of knowledge in all branches of the silk industry.

Before the war the silk-producing prefectures were the most prosperous, but the consequences of the war have presented them with far more serious problems than those which the rice-growers have had to face. Without taking into account the producers of cocoons, about 25 per cent. of the total factory workers of Japan were employed in silk reeling, and 15 per cent. in silk textile factories. Cotton yarns and cotton goods did not employ so many workers, although their output had greater monetary value both for home consumption and export.

Tea Japan tea is unknown in Western Europe, but the country is self-supporting in this commodity, except for very small quantities of imported tea used in the higher-class, foreign-style hotels and restaurants. The United States and Canada took nearly all the exports of Japan tea especially for the western and middle sections of the country. People on the Pacific seaboard states of the U.S.A. will still remember the China tea clippers and their long association with China. But Ceylon and Indian tea is now finding its way into the United States, the more so since the war has shut off supplies of both Japan and China teas.

The tea used for Japanese home consumption is of the green or unfermented type and, except for Japanese residents abroad, there is not much prospect of an export trade developing. For a time an attempt was made to develop a trade with the U.S.S.R. with a kind of green tea known as "guri-cha," but this has fallen far short of expectations. Before the war an attempt was made to open up a market in Morocco and North Africa.

Tea production in Japan proper is not increasing. As with rice, Japan now has under her control (Chinese and Javese supplies included) far more tea than she has outlets for. Japan's output of tea for home consumption and for export was, before the war, less than that of Java alone.

Secondary Cereals Barley, wheat, millet, rye and beans comprise the five food crops of Eastern agriculture. They are secondary in various senses. They are grown as a summer crop—especially rye and millet—where climatic conditions and irrigation facilities do not allow paddy field rice to be grown. Where rice-growing is possible, these cereals (especially the barleys) are sown in autumn and harvested in May-June. Nowadays wheat is used in the production of flour, although before the war this was augmented by imports from Canada and Australia:

it has always been used in the manufacture of "shoyu" or soy sauce. Some barley is used for brewing, but most of it is used for food. Beans are of considerable variety, and, with fish, constitute the nitrogenous elements in the Japanese diet. There are more beans—especially soy beans—available than are required for food, and the surplus is made into bean-cake for stock-feeding and, after oil extraction, an organic nitrogen manure.

These secondary group products are not considered as "money crops" by the farmers, but they form the main items of food for all persons below the rice-eating line, and this includes the peasantry and lower industrial workers.

Sweet Potatoes The sweet potato is not an indigenous crop, but it is now the most widely grown vegetable and a very essential food plant. It originally came to Japan by way of Mexico, the Philippines, China and the intermediate islands. Even as recently as thirty to forty years ago, the sweet potato was a national standby against famine in areas where excessive August-September rains and consequent floods ruined the paddy fields. Perhaps the latest of such experiences were in 1907, 1910 and 1913, for the Government now stocks imported rice and buys up home-grown rice in years of abundant yields. Even so, sweet potatoes are normally a substantial item in the Japanese diet of all classes.

Other Vegetables Next to the sweet potato (in quantity) come radishes (of huge size), sugar potato (a taro), Japanese onions (leeks), cabbage family plants, burdocks and egg plants, nearly all of which are eaten either salted or pickled. In the large urban centres vegetables of Western origin normally find a ready market, and a visit to a large city vegetable market used to be an enlightening experience. Irish potatoes are an established crop, and before the war large quantities were exported to the Philippines, Hong Kong, and other places where there were white residents.

Fruit The three most important indigenous fruits are oranges of various kinds, persimmon and a native pear. Excellent quality peaches, edible cherries, imported-style pears, apples and grapes have in recent years also been put on the market.

The only one of these which has been seriously affected by the war is oranges. The export trade in this fruit was considerable, especially for the Christmas trade in the United States, Canada, and even Great Britain.

Sugar Many unsuccessful attempts have been made in Japan to develop sugar beet. After Formosa came into Japan's possession in 1895, the national interest turned to cane sugar. By 1910 "centrals" were established on the Hawaiian model, and these were efficiently worked for the production of white sugar. Now that Japan controls the Java and Philippine cane sugar outputs, she has, as with rice and tea, far greater quantities than she can market. Java, for example, was until recently the third largest producer of cane sugar in the world.

Tobacco In Japan a Government Tobacco Monopoly Bureau controlled the growth, manufacture and sales of this commodity. A large part of the crop was grown under licence, and the total annual trade amounted to about 132,000,000 lb. Now that tobacco from the Philippines, Sumatra and Borneo has come into Japanese hands, the total quantity may be embarrassing.

In the loss of her export trade in silk, tea, oranges and a few other agricultural products, Japan's rural economy has suffered a very severe set-back, but it is the peasantry who have felt it most.

THE FOLDING FLOCK

MAJOR T. K. JEANS

Broadchalke, Salisbury

THE arable or folding flock, under the experienced management and control of a practical farmer, and in the care of a capable, conscientious and experienced shepherd, represents, more than any other farming unit, the fundamental principles of good farming and sound husbandry, combined with high production and the maintenance of soil fertility. It is a long-term system and requires careful planning for several years ahead. The flock must also be fitted in to the general organization and management of the farm with regard to a rotation of cropping and alternate husbandry, which will produce a succession of forage crops for the sheep to fold throughout the year. These crops not only provide the necessary seasonal food for the sheep; they are the source of manure made without waste and dropped evenly over the ground on which it is grown without cost of hauling, carting or spreading. Moreover, the necessary cultivations for these forage crops at various seasons of the year should keep the farm clean of couch and other noxious weeds.

Forty Years Decline Not all farms are suitable for a breeding flock. Much depends on the area, the character of the soil, and the general lay-out (low-lying, wet ground is not suitable). Each farm has its own problems and difficulties, which must be considered individually; and frequently their solution requires considerable experience. It is, of course, a very regrettable fact that many hurdled flocks have disappeared during the past thirty years, together with the old, experienced flockmasters and shepherds. Their long-term system of good farming undoubtedly led the world in high production and maintained the fertility of medium and light land, but the considerable amount of experienced labour required became expensive (even at very low rates of pay) during the deplorable times which farmers have had to face during the past forty years. Prices for agricultural produce were often so low that the only way to avoid financial loss in farming a very large area was to allow it to become derelict or to fall down to rough grazing, which could be ranched with mountain sheep and cattle. It was possible to make a profit in this way, but such practice can be regarded only as the prostitution of Mother Earth and must never again be tolerated.

The old flockmasters had to go, and their flocks with them. Their long-term system failed, not because it was wrong but because it required modernizing and mechanizing, together with reasonable prices, to meet the changed conditions. Many of these experienced, practical men had neither the new capital to invest in the requisite machinery nor the necessary modern knowledge to use it. Nor could they take advantage of agricultural science, of which they had no knowledge and, unfortunately, a very poor opinion and mistrust—especially of artificial fertilizers.

Livestock Products as well as Crops The wheel has now come full turn, and the keen young farmer of to-day, progressive, with a sound theoretical knowledge of agricultural science and a good general knowledge of machinery, is often in a great hurry to increase production. Frequently, however, he lacks the practical knowledge and experience of livestock husbandry and particularly of folding sheep. This may be a greater handicap to him than was the ignorance of modern science and machinery to the old flockmaster. The necessary experience of stock-keeping must be incorporated in the general plan and organization of the farm to produce meat and wool, and at the same time an increased quantity of other necessities of life—cereals, vegetables and sugar—by supplying cheaply and in the right place the most valuable of all plant foods—animal manure.

Modern farmers are inclined to shy at stock-keeping on arable land because it takes time to acquire the necessary experience, without which they cannot become efficient. We also see some modern agriculturists taking an immense amount of trouble with extended trials to ascertain how fertility can be maintained and certain necessities of life, such as cereals, vegetables and sugar, produced without live stock. Such practice can only be adopted at the expense of the production of the even more important necessities—meat, milk and wool—and does not make for *real* wealth. Scientific theory in agriculture seems to have raced too far ahead of practical knowledge, which has been so gravely handicapped, and in some cases almost lost, in the welter of evolution and economic depressions.

Animal husbandry is the backbone of English farming. Science can and must continue to assist it in conjunction with practical experience, not to *replace* it by new formulae. Prices, currency and foreign exchange are all controlled, and should be adjusted to meet and encourage, during difficult periods, the natural production of food, rather than the scientist be asked to reject the assistance of Nature by producing *some* necessities of life and nullifying the production of others.

Sheep and Sugar Beet Sugar beet may be a very alluring cash crop, but it should not be forgotten that its shimmering garment is mainly composed of a heavy subsidy. Let me hasten to say that I fully agree both with the subsidy and with the necessity of growing sugar beet in this country, but I cannot emphasize too strongly that we are simply deceiving ourselves by abandoning the substance for the shadow, and encouraging the younger generation to do likewise. If sugar beet is to be grown in Britain, as undoubtedly it should, then surely it should be possible to keep folding sheep which will greatly assist its production, consume its residue, and produce meat and wool of the finest quality.

Science and Machinery can help the Folding Flock There are many experienced farmers who believe that the practical application of science and modern machinery can and will restore the folding flock to the important position it held on so many of the most productive farms in this country within the past half century. In fact, it may be that the hurdled flock is the friend that will assist the farmer to take full advantage of arable machinery. I have seen some very deplorable results on mechanized farms where animal husbandry has been abandoned, and I have also seen very sad results where grass sheep have been taken from their mountain ranges and used in an endeavour to maintain fertility on more productive land. After two or three years the pastures and old leys become infested with stomach worms, the lambs cease to thrive and continual dosing is necessary. Unless there is a very large area

(Photo: Farmer and Stockbreeder).

Major Jeans's Pedigree Hampshire Down flock at Broadchalke, Salisbury, on roots prior to wheat

Potato Spraying in the South-West (See pp. 71-75).

Top : Spraying with row-crop tractor at Ottery St. Mary, 1943.

Bottom : Spraying with two horses at Barnstaple, 1943.

in which to run grass sheep and great care is taken, both the land and the sheep become infested and food production per acre declines seriously. With a folding flock, there should be no trouble with worms; their food is rationed every day by the size of the fold, and they are not allowed to run back on old, stale ground. The plough usually follows the sheep, and nothing cleans land of animal diseases more surely than the plough. A ley should not be folded more than once during a summer; if it is folded twice, a winter should intervene between the foldings.

Artificial Fertilizers behind Hurdled Sheep The use of artificial fertilizers is essential to obtain the best crop result behind a folding flock, but only small quantities are required: 1½–2 cwt. per acre, complete and concentrated, drilled with the seed in a combine drill, is ample for thin land on chalk hills. No top dressing of nitrogen should be given to the spring corn; otherwise the crop will be laid. Autumn-sown wheat will sometimes require a little nitrogen in the late spring, but it must be given with caution or the crop will go down.

Hay and Corn Harvesting A wire pick-up hay and straw baler is a great help. It makes far better hay than we made in ricks with hay sweeps. There is also a great saving of labour in hauling it out to the sheep and other stock during the winter, and it can easily be rationed. Hay can be baled at least one day before it would be safe to stack it. The bales should be put up on end in the field and not stacked for a week or ten days; rain will not enter wire bales if on end. They should not, of course, be stacked until the outsides are dry.

I cut about half my corn with a combine-harvester, but I have no intention of giving up my binders. Though I have used combine-harvesters for seven or eight years, I have never dried any corn artificially. I have no grain drier, and hope it will never be necessary for me to have one. A power winnowing machine is desirable. But I do advocate central driers in corn-growing districts. Many farmers, myself included, required corn driers far more in the past to dry damp corn from unthatched or badly thatched ricks, than they will in the future if they use a combine-harvester-thresher *judiciously* and with care. I find a binder is still necessary on a mixed farm.

Corn ricks are placed where the lambing pen will be made, and all the straw converted into manure on the higher ground, whence it is subsequently hauled down-hill to adjoining fields that require it.

Folded Sheep may solve the Surplus Straw Problem A combine-harvester is liable to waste corn on undulating ground, but when it is suitable it saves much time and labour; the thatching of ricks is also avoided. With this new implement, the folding flock again comes to the rescue. On many farms where combine-harvesters are being used there seems to be difficulty in dealing with the straw. Sometimes it is burnt and its manurial value largely lost; if it is left as it comes from the machine it is very difficult to plough in. When the straw is not required it should be converted into manure by folding sheep, then it can easily be ploughed in. The corn should be undersown with hop clover (trefoil) and Italian ryegrass, 8 lb. of the former and 15–20 lb. of the latter per acre. A straw distributor should be fitted to the combine to spread the straw equally over the ground. If necessary, directly the corn is cut a top dressing of 2 cwt. per acre of nitrogen will encourage the grass to grow up quickly through the straw and make an excellent sheep feed which, during the mild autumn, can be folded sometimes as late as Christmas. The straw can then easily be ploughed in as manure where it was grown. How can fertility be restored more economically?

Arable Sheep and Ley Farming A folding flock will fit into the general management of ley farming, or what is sometimes called alternate husbandry, and the loss of one season's production in summer fallowing to clean ground should not be necessary. My experience is that on the light hill land, grass seeds take far better after the golden hoof, even though the seeds are sown in the second corn crop after sheep.

The necessary hauling for sheep is slow and laborious work with horses, but it is greatly facilitated by a high speed, rubber-tyred tractor; the hauling of water in the summer months should not take long with a big water barrel on pneumatic tyres. Modern machinery has again made arable and/or ley farming possible in this country; it has also made it possible to impoverish and over-crop land far quicker than in the past. We can modernize and mechanize the old farming principles of animal husbandry with advantage, but we must work with Nature, not against her.

ROOT HOEING

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HOEING of root crops is carried out primarily for the destruction of weeds, and to a less extent in certain districts for the conservation of soil moisture.

The number of sets of hoe blades on the hoe frame must be equal to, or an exact sub-multiple of, the number of coulters in the drill. For economy's sake the hoe frame should be as wide as possible, whether the motive power be tractor or horse.

The first hoeing should be done as soon as the rows are visible, the side hoes being set as close as possible to the plants without covering them with soil. If soil conditions are suitable, rolling with a Cambridge roller or a flat roller, especially the former if the land has become "crusted," will improve the working of the hoes and reduce the risk of covering the plants with soil. For the first hoeing, protecting discs on either side of the row of plants, or special hoes with protecting points and heels, will prevent damage of the seedlings. If during the hoeing operation just prior to singling, dished discs set at a slight angle are substituted for the plain protecting discs, the plants are left on a slight ridge, and this facilitates singling.

As soon as the plants have recovered from singling and are standing upright, the hoes should be used again to move the rubbish and unwanted plants in the centre of the row and to push soil back to the singled plants. Hoeing should continue as often as is necessary to keep down weeds, the final hoeing being done with an A-hoe, cleaning the centre of the row which is not covered by the foliage of the crop. Experiments indicate that it is harmful to do this final operation on sugar beet with a deep cultivator tine.

POTATO SPRAYING IN THE SOUTH-WEST, 1942 AND 1943

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THERE is still a tendency, not only in the South-west but also in other parts of the country, to think that if Potato Blight causes little disease in the tubers it can have done little harm. The mistake in this point of view, which ignores the loss of crop due to premature decay of the haulm, has been shown up very clearly by our experiences in the past two years.

Continuing the work begun in 1941,* we have conducted some dozen spraying demonstrations each year in conjunction with the Technical Development Committees for Devon and Cornwall, in addition to more elaborate field trials. At all these centres the progress of the disease on the foliage has been studied, and the yields from sprayed and unsprayed plots recorded.

Blight Attack and Results of Spraying in 1942

An unusually severe winter, a cold spring, and a dry June retarded potato growth during 1942. Blight attack was also late, beginning about mid-July in south coastal districts; and elsewhere it had not made much headway until mid-August, by which time the main-crop tubers were about half-grown. The weather during August was warm and wet, and once Blight did start, it went ahead rapidly. Most of the unsprayed potatoes were completely defoliated by the end of the month, when, of course, the growth of tubers stopped.

On the demonstration fields two sprayings were given, in accordance with our general recommendation for all years; the first about the beginning of July, the second towards the end of the month. With Blight attack so late, the first spraying proved an insurance against a risk that did not materialize, but the second spraying was aided by the subsequent weather and had a remarkable effect. It kept the tops green through all August's rain and mist until the dry September, when the plants grew on without need of further protection and produced their full crop. Results, where Bordeaux mixture was used, were as follows:

Yields of Potato Crops Twice Sprayed with Bordeaux Mixture

Centre	Variety	Yield of Ware (twice-sprayed)	Gain from Spraying
		Tons per acre	*Tons per acre*
Launceston	"A" Scotch Arran Banner ..	17.9	3.3
Bodmin ..	Thrice-grown Arran Banner ..	7.0	2.6
Truro ..	Once-grown Arran Banner ..	6.8	3.5
Chagford ..	Twice-grown Great Scot ..	9.4	2.5
Bideford ..	Once-grown Up-to-Date	14.7	3.3
Bude ..	Once-grown Arran Banner ..	10.6	2.5
Kentisbeare	"A" Irish Majestic	12.0	5.2
Dartington	"A" Scotch Majestic	10.8	4.0

It should be noted that these figures make no allowance for headlands or for tubers inevitably left in the ground when lifting with a spinner or

* See this Journal, 48, 235.

plough, but even so there was clearly an average net gain of well over 2 tons per acre.

Blight Attack and Results of Spraying in 1943 Any idea we might have had from our experience in 1942 that one late spraying would be sufficient was promptly corrected in 1943. In this season, following a mild winter and an early spring, the potatoes grew away unchecked. They cropped early, and Blight also came early—owing to very humid weather in May and early June. In central Devon Blight began about the first week in July, and most of the unsprayed potatoes were half dead before the end of the month. The first spraying was of supreme importance, and the second spraying was also very necessary, for both August and September were wet. Indeed, we had one of the worst Blight years in living memory. Our standard recommendation of two sprayings was put to a severe test, and it was fortunate that in this year we had our work well set to a uniform plan. We kept to a single variety (Majestic), and used all 14 of the demonstration fields as parts of a single large-scale field trial, with two sprayings of Bordeaux mixture only, over a wide range of soil and climatic conditions.

Spraying Pays Best where Good Seed is Planted As we had found in previous years that the gain from spraying was usually greater where good seed was planted, in 1943 we also tried the effect of spraying, at all centres, on Majestic from new seed ("A" certificate, Devon, Scotch and Irish) and on Majestic from old seed, several-years grown, in which about one-third of the plants was debilitated by Leaf Roll or severe Mosaic. Results were:

Comparative Results of Spraying Certified and Uncertified Seed

Centre	"A" Certificate Seed		Uncertified Seed	
	Total Ware (twice-sprayed)	Gain from Spraying	Total Ware (twice-sprayed)	Gain from Spraying
Chulmleigh ..	18.5	4.7	10.1	2.6
Ottery St. Mary	12.5	nil	9.3	nil
Torrington ..	12.6	3.8	5.7	nil
St. Columb ..	11.4	3.0	7.3	1.3
Bodmin ..	11.2	1.3	7.7	1.4
Okehampton ..	10.2	4.2	6.0	1.7
Bridford ..	8.7	1.7	7.1	2.2
Barnstaple ..	8.5	0.5	5.9	nil
Hatherleigh ..	7.9	1.4	5.1	0.1
Lewdown ..	7.9	4.3	4.5	1.0
Buckfastleigh ..	7.5	2.3	5.6	1.6
Grampound Road	6.0	1.9	2.4	0.2
Kingsbridge ..	5.4	0.1	4.6	1.1
Fore Down ..	4.1	0.1	2.8	nil
Average ..	9.4	2.0	6.0	0.8

In the above Table the figures for "Total Ware" comprise all sound tubers over 1¼-in. riddle, and again no allowance is made for headlands, wastage at lifting or in store. But the net gain from spraying the crops from *good seed* was well over 2 tons per acre. With the poor, uncertified seed, the plants at many of the centres simply had not the vigour to profit from the longer period of growth which spraying gives, and the average

gain from spraying on the poor seed was less than half as much as that from spraying on the good. This is a point of the highest practical importance that has often been overlooked in past spraying trials. At Grampound Road, near Truro, all the yields were light because we were late with our first spraying (June 26), and the Blight already present on the haulm was only partially checked. At all other centres the sprayings were given in good time.

Soil Factors The so-called "Potato Rust," usually associated with potash deficiency, is often responsible for apparent failures of spraying to increase the yield. The results at Barnstaple and Kingsbridge illustrate this point. At both these centres the plants dried up with "Rust" before Blight could make much difference. At Ottery St. Mary the haulms were also yellowing off by reason of some mineral deficiency before the Blight, which is always latest in East Devon, could take effect. And apart from "Rust," the gain from spraying on the poorer soils, like the total yield, was less than on the better soils.

Spraying Methods The innovation in 1942 of using row-crop tractors for spraying on our "sideling" or steeply sloping fields was an immediate success. It has enabled the contractor, with a good man on the job, to spray 10–15 acres a day with each 120-gallon 5-row machine, even allowing for journeys between neighbouring farms. It also saved much arduous labour, for otherwise it is often necessary to use two horses, or to work with half-charges in the sprayer to reduce the weight.

So long as the plants are not more than about knee-high and are still upright, the tractor outfit, with wheels properly adjusted to the width of the rows does so little damage that on the day following the spraying it is by no means easy to see where it has been through. Only occasionally, for the second spraying, has it been necessary to remove the tractor hitch, fit up the spare shafts which are always carried with the outfit, and do the job with a horse. When the haulms are very heavy and sprawling a good deal of cutting by the sprayer wheels themselves is inevitable, but this occurs only in two rows out of five, and at the second spraying it is generally wiser to put up with the cutting of some of the haulms, rather than have them all destroyed within a short time by Blight.

The Water Problem The sprayers apply from 100 to 120 gallons per acre. The provision and handling of the water required has been the principal difficulty. Usually the farmer has to bring the water to the field in such tanks or barrels as he can get together, and even then it still takes as long to fill the sprayer with a hand pump as it does to do the actual spraying (15 to 20 minutes per charge or per acre). Sometimes, as at haymaking, labour cannot be spared.

One good way over the difficulty was that adopted last year by the Devon Machinery and Farms Departments. Each of their spraying teams had a 500-gallon closed tank, a small rotary pump driven by a 1½ h.p. petrol engine, and the sprayer, all mounted on a lorry. On their way to the job they stopped at the nearest river, threw a long suction hose (with an efficient strainer) over the bridge and pumped their tank full in about 10 minutes. On the field they again used the engine-driven pump, with a long delivery hose, to fill the sprayer quickly from the tank.

Spraying Materials Most of the contract spraying has been done with proprietary materials of the modern kind containing 50 per cent. copper. These have given good results, and sometimes, in comparative trials, they have equalled Bordeaux mixture, but they have never surpassed it in any respect, and more often they have given inferior protection. Cuprous oxide sprays have shown a marked tendency under some conditions to cause a premature yellowing of the potato haulm, while Bordeaux mixture has shown an equally marked tendency to preserve the green colour of the haulm as well as protecting it from Blight. In the course of our trials, which have included many hundreds of analyses of sprayed leaves, we have found no cuprous oxide or other proprietary spray to equal Bordeaux mixture in its power of resisting washing off by rain. *Under field conditions*, with the most detailed and repeated assessment of the progress of disease on the sprayed leaves, we have found no evidence that copper in the form of cuprous oxide possesses any superior potency to that in Bordeaux mixture to compensate for the smaller amount retained on the leaves. There is the further consideration that Bordeaux mixture is much cheaper than any proprietary spray. At 120 gallons per acre, 1 per cent. Bordeaux mixture (12 lb. *granulated* copper sulphate plus 15 lb. *hydrated* lime per 120 gallons) cost about 4s. 9d., buying materials only in hundredweight quantities, while the cost of a cuprous oxide spray at £8 per cwt., using 6 lb. per acre, was about 8s. 6d.

MAKING UP BORDEAUX MIXTURE To make up 120 gallons of Bordeaux mixture, tip a 12-lb. measure of granulated copper sulphate on the sieve of the sprayer while the water is being pumped in. The fine crystals dissolve and wash down by the time the sprayer is about three-parts full. Meanwhile half-fill a large galvanized pail with water, tip in a 15-lb. measure of hydrated lime, and stir to a cream. Pour this through the sieve into the sprayer and wash down with the remainder of the water. Then lift off the sieve and work a pole about in the barrel for about two minutes, until the blue colour comes to the surface. The charge of mixture is then in the sprayer and ready for use.

We have found that this method takes no longer than making up proprietary sprays: it is all done while filling the sprayer, and except for an ordinary pail, no extra barrels or other utensils are required. There is no trouble from blocked nozzles, and the spray is evenly distributed, as is shown by the uniform blue colour of the foliage seen across the field as soon as the spray has dried. This coloration by Bordeaux mixture enables the farmer to see for himself that the spraying has been done properly. One reason why we prefer Bordeaux to any form of Burgundy mixture (copper sulphate and soda) is that the soda requires an appreciable time to dissolve, and even with "ready-made" Burgundy the mixing cannot be done as quickly or as easily.

Cost of Spraying Contractors, using a proprietary material, usually charge about 25s. per acre for each application, the farmer providing the water. In Cornwall the charge is on an hourly, and not an acreage, basis, so that if the contractor has to provide water he is covered for the work. In Devon the Machinery Department charge for the whole work, including cartage of water, was 30s. per acre in 1943.

Spraying Small Acreages The contract charge is usually stepped up rather steeply for small acreages, and farmers with 1 to 4 acres can save money by buying a 2-row cart spraying outfit, or hiring it (as in Devon) at 5s. a day, and doing the work themselves.

The spray boom with its lances is clamped to the back of an ordinary farm cart, in which the 40-gallon tub with hand pump is placed. The outfit is quite efficient, and a small piece, up to 4 acres, can be sprayed in a single day. The cart sprayer can also be used for spraying charlock with copper sulphate (40 lb. per 100 gallons), and for burning off potato haulm, not with acid, but with copper sulphate and common salt (20 lb. of each per 100 gallons), which takes about a week to kill the haulm but can be used with safety by anybody.

Blight in the Tubers Spraying reduces the risk of tuber infection in the soil at first by delaying the attack on the foliage for some weeks ; but it can occasionally increase the risk of infection in the soil later by keeping the haulm partly green even in October. There is nearly always some Blight even on sprayed foliage at the end of the season. The remedy for this is to burn off the haulm with acid, or with copper sulphate and salt. But in Devon we have found that burning off is rarely worth while. In all our trials the proportion of diseased tubers has been small, and spraying has made little difference to the amount of disease in them one way or the other. The overall effect of two sprayings with Bordeaux mixture in the past two widely differing seasons has been to increase the sound, marketable crop by about 25 per cent.

OUTDOOR TOMATO-GROWING IN EAST CORNWALL

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Cornwall County Council

THE following is an account of work carried out last year under the direction of the Horticultural Superintendent (Mr. H. W. Abbiss) at Ellbridge Experimental Station, which is situated on the Cornish side of the river Tamar, some ten miles north-west of Plymouth. Outdoor tomatoes seemed to warrant special attention as a war-time crop, but demonstration, and tests were necessary to convince small growers that outdoor tomatoes could, even with limited equipment, be profitable in the humid Cornish climate.

In 1943 we had the experiences of 1941–42 to draw upon, both from the viewpoint of suitable varieties and methods of culture. Our plots have also formed part of Dr. Bewley's national variety, training, staking, and spraying trials.

The following notes concern chiefly the special difficulties encountered, the methods of overcoming them and the results obtained.

Artificials Only The Ellbridge site has a favourable southerly aspect, but is somewhat exposed to south-westerly gales. The land, from which a spring cabbage crop had been cleared, was ploughed and aerated by the frequent use of a rotary cultivator. No organic manure was available, and we had, therefore, to depend on a mixture, worked in

about a fortnight before planting, consisting of:

	cwt. per acre
Superphosphate	4
Muriate of potash	2
Sulphate of ammonia	2

Seedlings under Dutch Lights A local grower germinated the seed in heat during the last few days of March, and the seedlings were brought to the Station and pricked out during the third week of April in a range of forty Dutch lights—the only glass on the Station. In this way we were able to demonstrate to growers, the majority of whom are without glasshouses, that strong, sturdy plants can be obtained for planting out at the end of May. The distances of planting were 3 ft. between the rows, with plants 18 in. apart in the rows.

Staking Staking is a matter of importance in the area, owing to the frequency of strong winds, but fortunately good ash stakes can readily be obtained from the hedges.

The most effective and economic method of training and staking the plants was found to be a single-stem plant supported by an overhead wire; alternate plants were supported by a cane, and intervening plants by sisal twine. Three-ply fillis twine, which is often used on indoor tomatoes, is not strong enough or sufficiently durable out-of-doors.

Spraying is a Sound Insurance Very unfavourable weather from the point of view of the tomato-grower was experienced throughout the season. Humidity records show that Potato Blight could have spread on all but two days of the period of the demonstration. Rainfall was heavy and sunshine was lacking, as can be seen from the following Table:

Month	Rainfall			Sunshine	
	No. of days on which rain fell	No. of days when precipitation was more than 0·1 in.	Total rainfall	No. of days	
				Under 3 hr.	Over 6 hr.
			in.		
June	17	8	1.75	8	16
July	18	11	2.47	10	15
Aug.	20	10	4.51	13	12
Sept.	19	13	4.86	9	14
Oct.	19	14	5.85	15	10

It was necessary to start spraying as early as June 15 and to continue until September 17; and from July 16 to September 17 applications were made at least once a week. In all, nine wet sprayings and five dry dustings were given; the less effective dry dusting was necessarily used during foggy and misty periods.

Several sprays with copper bases were used, including Bordeaux mixture, ammoniacal copper carbonate, etc., and several proprietary materials. The wet sprays were applied at a pressure of 100 lb. by means of a spraying attachment to a 3½ h.p. Auto-Culto cultivator, and the dust

was applied by a rotary blower. Growers in the area often asked: "Is it economic to spray so often?" The answer is emphatically, "Yes," as was proved by the excellent crop which the Station harvested. Indeed, many growers failed to bring their crops to the marketing stage simply because their sprayings were insufficient in number. It is unquestionably of paramount importance to keep the premium of this insurance policy paid regularly.

Stopping was carried out at the end of July, when most of the varieties were carrying four trusses of fruit.

At the time of stopping, the plants were very vigorous, and, since they had received so little sunshine, it was decided not to apply a complete fertilizer as a top dressing. Potash only, at $1\frac{1}{2}$ cwt. of muriate per acre, produced a marked beneficial effect by hardening the plants.

Partial defoliation by the removal of the lower leaves to the second truss was carried out on September 17.

Acceleration of Ripening It was at the ripening stage that the effects of a most unfavourable season were felt, and several methods were tried to accelerate ripening. The following were the most successful:

1. The plant was given a sharp pull to break the feeding roots, but not sufficiently strong to destroy the anchorage or to expose the roots. This was only partially successful as the reaction was slow.
2. Almost complete defoliation was far more successful, in that the reaction was quicker. No harmful effect was observed upon the fruit.
3. Fruits were picked as soon as they began to turn yellow. They were then placed on straw under shaded Dutch lights and ripened sufficiently for marketing within a week. With adequate ventilation there was no loss of fruit.

Varieties Probably the most valuable information obtained from the trials concerned the performance, under Cornish conditions, of the 33 varieties tested; 115 plants of each variety were grown. Those regarded as the best were the varieties which gave the highest yield of first-grade fruit; that is, firm fruit of good shape and colour. Total yields varied rather widely, but 10 varieties gave yields of over 6 lb. per plant and another 10 yields of over 5 lb. per plant. Some, for example, Clucas 99, Victory, Prolific, Moneymaker and, to a less extent, Fillbasket, gave too high a proportion of green fruit. The first three of the above, together with Sunrise, showed a marked tendency to split and to become infected with *Botrytis* at the calyx end.

Further information useful to the grower regarding the habit of the plant was also recorded. For example, the dense, heavy foliage of Victory, Express, March Beauty, Progress, Tamar Valley, E.C.B., Prolific, Stambovoi and X-Ray hindered effective spraying, and the lighter, less-foliaged varieties are regarded as more suitable for Cornish conditions.

Note was also made of the average height of the plants—an indication of the length of cane required—and the type of truss. The compact, bunched truss, characteristic of such varieties as Ailsa Craig, Kondine Red, M.P. and Unrivalled Open Air, does not require additional support, and thus saves labour during the busy period. In general, fruit size, though variable, was quite satisfactory for marketing purposes but with some, for

example, Fillbasket and Express, it was very large and rough ; in others, such as Sunrise and X–Ray, it was undesirably small.

Space does not allow full details of all the varieties grown to be given, but the following may be regarded as varieties that gave a satisfactory performance and which can be recommended as likely to succeed in Cornwall.

Varieties Suitable for Cornwall

VARIETY	TOTAL YIELD	CHARACTER
	lb. per plant	
Hundredfold	6.9	Very tall. Sparse foliage. Truss compact, but with long stem requiring support. Moderate-sized fruit.
Stonor's M.P.	6.8	Compact growth. Sparse foliage. Medium truss not needing support. Medium to small fruit.
Ailsa Craig .. .. (Dr. Bewley)	6.3	Tall, moderate, spreading foliage. Compact truss not needing support. Medium-sized fruit
Kondine Red	6.2	Close-jointed plant Moderate foliage. Compact truss. Fruit medium size, some rough.
Bide's Recruit.. ..	5.9	Tall plant Moderate foliage. Spreading truss. Fruit medium to small size.
Market King	5.4	Tall plant. Light foliage. Long truss requiring support. Fruit small.
Amwell	5.1	Compact plant. Medium foliage. Long truss requiring support Fruit medium size.
Unrivalled Open Air ..	5.0	Short plant. Light foliage. Short-jointed double truss not requiring support. Fruit medium size.

RESTORING POACHED LAND

W. A. Scriven, N.D.A., N.D.D.

Staffordshire War Agricultural Executive Committee

LOOKING around the countryside during the winter months, one is struck by the extent of poached land to be seen—particularly in the dairying areas, where animals are turned out daily for exercise or grazing. Quagmires at the gateways and field connexions are to be found on practically every farm, but very often the trodden areas extend far into the fields. Not uncommonly these areas remain barren for months, or eventually become covered with weeds, such as Persicaria, buttercups, docks and mayweed. Where poaching has not been too serious, chain harrowing and rolling may heal the surface and assist the remaining grasses

to cover the ground. In the gateways, however, drastic levelling will usually be required. Better still, where possible the mud should be dug out and replaced by hard core or chalk and covered with clinker. Such fields are often devoid of good herbage ; in its place flourish inferior grasses, such as Annual Meadow Grass, Yorkshire Fog and Soft Brome. Thus acres of potentially good, perhaps the best, grassland are lost to food production just at the time of the year when keep is most valuable to the farmer.

Harrowing and Seeding As soon as the weather permits during April or early May, the trodden areas should be levelled by several chain or other harrowings. A few days later seeds should be sown and covered in. Rolling must be done only when the surface of the ground is dry ; otherwise the soil will stick to the roller and pull up the seeds.

Some years ago the writer treated 4 acres of a badly trodden field in this way. After the necessary chain harrowing for levelling, a mixture of Italian, Westernwolths and perennial ryegrasses was sown at approx. 20 lb. per acre in early April and rolled in. When the field was cut for hay at the end of June the seeded area was superior both in yield and quality to the rest of the field.

On another occasion a poached area was treated and sown in May with a mixture of seeds fallen from good "seeds" hay, swept from a stable loft, and though cattle trampled the seeds in the early stages, this area helped to provide excellent grazing throughout the season. Loft seed, unless from good clean "seeds" hay, is not to be recommended, owing to the risk of introducing weeds. As a rule it is better to sow Italian and perennial ryegrass ; and where the land is unlikely to be trodden badly the following year, a mixture of ryegrasses and clover. The following seedings can be recommended :

Where Fields are Trodden Annually

	lb. per acre
Italian ryegrass	10
Irish perennial ryegrass	8
TOTAL	18

Where Fields may not be Trodden Again for Several Years

Italian ryegrass	6
Irish perennial ryegrass	5
Aberystwyth S.24	5
Timothy	3
White clover S.100	1
TOTAL	20

Where land is heavy and badly trodden, the above seeding rates should be increased ; conversely, on land less trodden the seeding rate can be reduced, since many of the original grasses remain and stool out, which, with the new seeds, quickly cover the ground.

If cattle can be kept off the seeded area for several weeks or an alternative entrance to the field can be used, so much the better, but even where this is impossible, it is surprising what little further damage is done when the land dries in spring, and how soon it is again covered by a green sward.

REALISM IN RURAL LIFE

F. G. Thomas

It is evident that there will be an increased population to be housed in the countryside after the war to meet the needs of agriculture, dispersed industries in rural areas, and the overflow of the towns. There is room enough for such development without encroaching on good agricultural soil, and indeed the main hope of any rural progress will depend on our success in reversing the social trends of the last century by bringing new people *into* the country.

New People and a New Policy

But they must be the right kind of people. There are many rural areas which have suffered in the past from an influx of people who, while wanting to live or sleep there, had little or no economic interest in the land. Some, ekeing out small pensions, wished to live cheaply; others merely sought a house and a garden within daily travel of their work in town; and there were others who, without understanding the land or the crafts of farming, brought little capital and less skill in the vain hope of a good return. These were some of the more recent newcomers. They had no roots in the countryside; they did not belong socially or economically. They were as unrelated as the roadhouse and the neon sign.

The new people must have an economic relationship with the land; they must look to the land and the industries there for their livelihood; they must be young enough to rear families who will belong to the land; they must have ambition which will demand and create better social services and household amenities. If this is to happen the new settlement must be stimulated and prepared by a sound rural policy securing the right use of the differing soils, the dispersal of suitable rural industries and by the assumption of many responsibilities, previously exercised by the good landlord. We must so arrange the incidence and distribution of local and national taxation that the rural areas may have money to finance public services that are the right of the modern citizen. A co-ordinated national policy of development is necessary which, while outlining and making provision for common rural needs will be flexible enough to be related to local conditions.

There is danger lest any blueprint for the countryside as a whole may lose the infinite variety of English rural life, which is our rich heritage. This variety is manifest in the differing shapes of our fields and enclosures, the sizes of the farms and the methods of farming, in the characteristic movements and speech of the people, in the form and materials of village buildings, and in the meandering by-ways and footpaths of the parish. These variants of rural life are of significance. They derive from the lively rural times when the countryside was well founded economically and social life was vigorous, expanding and adventurous. Much of this vitality, it is true, had passed before the turn of the present century. Although many a townsman saw a nostalgic beauty in the life of contemporary villages, that same life was for many a villager "of the earth, earthy". Those who believed deeply in the importance of a sturdy rural life as part of the well-being of the nation were powerless to help because there was no economic base, no foundation on which to build in our time. In such a state of affairs the revivalist reformer flourished and committees for the councils of the countryside multiplied. Organizers, administrators and lecturers descended on the villages. Social services were to some extent improved and extended. But the realist knew that all these were

of little avail; the young people still left for the town—because there was little of economic or social interest for them in the village.

Future Development rests on Post-War Needs

The present war, as is usual, has brought a new liveliness into country affairs. It has brought new resources to the farm. Industries have been set up and, overnight, workers have been directed into the country for the duration. But one must not be misled by these events. Much of what is happening is ephemeral; it serves only a war purpose and will pass. Thousands of workers and many business executives long for the day of their return to the towns—they have no roots in the country.

Future development will be conditioned by post-war needs. These will be no less urgent, though different from those of war. An important factor perhaps will be our national plans with regard to the land. Policy must precede plans. Such policy will declare the function of the countryside in relation to national well-being. It will have regard to the international as well as the domestic needs of the people to be fed. If wisely conceived, it will evoke the innate, native rural instincts of our people who, in spite of our industrial detour, are still, at heart, of the countryside.

Town and Country March Together

This is not to decry the towns or modern industry. The modern towns, that is those arising from the industrial revolutions, are an essential part of our life, and if they have their evils, it should not be forgotten that the older, "historic" towns and villages have also their own horrors. A slum does not cease to be so because of thatched roofs. Outdoor sanitation is no more pleasant in the country than in the town.

It is futile and misleading for town to be set against country, or vice versa; town and country have always been economically and socially part of the whole. If the new town has overlain much of the countryside and sapped the best manhood from an ever-increasing encirclement, that is the more reason for a new synthesis and new controls maybe, but not vain attempts to isolate the town or to preserve the village. A greater mobility of people between town and country is desirable, not less. What has previously been only one way traffic must become a shuttle service. People do not mind living in a village, but they do resent being tied to it.

So then, the village of the future will be more closely related to the town, and its people will demand greater freedom of movement and better standards of living. This means that the countryside must be so well founded economically that it can yield the necessary income to provide these amenities. As these amenities are more expensive to provide for a scattered population, living in the countryside may, on the whole, be more expensive. The "cheapness" of the countryside is the townsman's illusion and the countryman's poverty.

The assumption that a countryman's wages should be below those of the townsman is an economic fallacy that has been our undoing. It has meant a lower standard of life for the country worker, and has accentuated the continual exodus to the towns. Poverty may be more endurable in the country; but it is none the less undesirable.

The results of such a theory are widespread. Agriculture suffers because it seldom attracts the most energetic and progressive type of worker, and so the foundations of rural life are undermined; the village suffers because local rate income cannot provide the minimum social services, and the life of the area is deprived of its lively members who have gone

to the towns. The towns suffer by a constant influx of workers seeking work and homes in already overcrowded areas. Those remaining in the village become more reactionary, sceptical and loth to disturb what is for fear of what may be.

Essential Character of Village must be Preserved If the countryside is to be important in the life of the nation, we must conserve the traditional characteristics of the village. We must not allow the village to grow into an urban district, which is, too often, neither village nor town, too small to be socially efficient and too large to retain the social traditions of the village. A village is a rural community, an integral part of the countryside, its people living and working on the land or in nearby industries—such as quarrying, processing factories or modern unit industries. This physical contact of man with the living processes of nature is fundamental to village life. If the majority of the people in the village are not concerned directly with the land, the community soon becomes urban-minded, and the very nature of the villager changes.

There is a rural way of living which is difficult to describe but easy to recognize. The rhythm of thought and of movement is based on the rhythm of life as worked through the seasons. The very solitariness of country jobs and the personal relationships in the village are basic to the strength of the countryman's character. Such qualities go to make up the yeoman farmers, and workers, who have been one of the progressive groups in English history—until poverty sapped the vitality of the village. Men of ambition left the village to escape its poverty. But the same countryman, given a job to do and adequately paid, will be progressive, cautious, original and individual in his thought and action. By the nature of his work and the condition of his life, he is more able to see "life steadily and see it whole". These are vital elements in democracy.

So then the village of the future must be well founded economically, rural in setting and with industries so dispersed as to add to its economy without destroying its rural traditions. Such a village may be fostered by wise policy and may be conserved by sound planning: it cannot be preserved by prohibitions. There is little to preserve; but there is a tradition and a mode of life tested through countless generations which, if rightly nurtured, may create a fresh vitality among a new people.

There must be changes in form of this tradition. Squirearchy is dead. There are few landlords with the means to carry out the functions of the old landlord at his best. The old craft industries have passed. Here, the tradition has exhausted itself and the money is lacking. But there are already new possibilities in local government, modern invention and science, to give new form to the old tradition. These are the "Signs of our Times". We have the mechanics of rebuilding within our ken; we can revitalize a whole area by controlling the watersheds—as has been done in America by the Tennessee Valley Authority. We have a people in whom a love of country and native skill are not yet dead. What is wanted is a policy conceived in terms of a hundred years.

The New Realism Finally, while the needs of the new population must be foreseen and planned and the erection of new buildings must be controlled, such planning will be merely a paper abstraction unless it derives from a sound economic and social belief in, and a true understanding of, the countryside.

REALISM IN RURAL LIFE

We must beware of the discordant voices of rural enthusiasts, from the revivalists of crafts and "folk" to the popular guide to quaint inns and the antique customs of "gaffer". Too often they mistake the form for the spirit: they winnow the husks.

The English village has grown and changed as the social ideas, beliefs and economics of our rural society have changed. The present decay of rural life reflects our current and recent disbelief. A new realism is needed which will harness the engineer, the agriculturist, the farmer and worker, the industrialist and the economist, and all those who believe in the value of this oldest and well-tried way of living. We must re-create in our time and for the future a countryside of lively and prosperous country people.

CONTAGIOUS ABORTION AND CALFHOOD VACCINATION

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It is doubtful whether any subject in veterinary medicine has received more attention during the past 40–50 years than bovine contagious abortion, and since 1897, when Bang discovered the causal organism, now known as *Brucella abortus*, many attempts to produce an immunizing agent have been undertaken both in the laboratory and in the field. Many substances were tried, including vaccines and chemotherapeutic agents. Unfortunately some of the vaccines used were suspensions of live *Br. abortus* organisms of full disease-producing power, and these, while undoubtedly reducing the actual numbers of abortions occurring in infected herds, had the serious drawback in that they had a tendency to cause permanent infection. Indeed the inoculated animals may have continued to harbour the organisms and, by excreting them, become potential sources of infection to the susceptible and non-vaccinated animals, and a danger to public health. The tendency was thus to propagate and perpetuate the disease in the herd rather than to eradicate it.

Strain 19 In recent years, however, certain vaccines have become available which are without these undesirable qualities. One is the Strain 19, with which so much work has been carried out in America by the Bureau of Animal Industry. It is an attenuated (weakened) strain, which is considered to be fixed in its degree of attenuation—that is, even under favourable conditions it is not capable of assuming the characteristics of virulent *Brucella*. It is prepared by the Ministry of Agriculture and Fisheries, at the Weybridge Laboratory, in exact accordance with the techinque developed, and tested by the United States Government for issue to veterinary surgeons as the No. 1 (Standard) vaccine. In Britain it is recommended for use in non-pregnant female bovines of all ages over 4–5 months, and has proved, from both experimental and field results, to be an immunizing agent of high order.

Inoculation at 4-8 Months Old Much of the work on Strain 19 in the U.S.A. and other countries has been carried out with the method of control called calfhood vaccination. This consists of inoculating the female calves at between four and eight months of age, with the sixth month being regarded as the optimum period. A reaction to the *Br. abortus* agglutination test is usually produced, but almost invariably this is lost by the time the animals calve for the first time.

The system is dependent on several basic factors associated with our knowledge of the disease. Frequently the calf of an infected or aborted cow harbours *Br. abortus* organisms in the stomach and other organs; or, if the dam is infected in the udder (a frequent habitat of the organism in the mature animal) infection of the calf may occur through the milk. Contrary to what happens in many other diseases, however, the young infected calves rapidly throw off the infection and later enter a susceptible period. Thus any apparent immunity in a mature animal is probably due to repeated exposure to *Br. abortus* during this susceptible period, and particularly during the period prior to conception. After the calfhood stage has been passed, the susceptibility to infection gradually increases with maturity and rises to a peak when pregnancy has become established.

The purpose behind the vaccination of calves, then, is to lay the foundations of an immunity after the calf has passed through the resistant period of its life, and before it enters the susceptible period. Any infection which the protected animal picks up after inoculation (within limits, of course, for the immunity to contagious abortion is not by any means absolute, and can be broken down) should enhance or reinforce the basic immunity established by the vaccine.

History of Trials with Calfhood Vaccination The first work on calfhood vaccination was conducted by an American worker, Buck, in 1925, using strains of *Br. abortus* of different degrees of virulence. Following this, the method was tested more extensively by Cotton, Buck and Smith and, using Strain 19, by Cotton and Buck. The results were encouraging when compared with control groups of unvaccinated animals, and since then much work on the subject has been carried out and favourably reported on, not only in America, but also in Canada, Sweden and other parts of the world. In January, 1936, the U.S. Department of Agriculture instituted, through the Bureau of Animal Industry, a large-scale field trial with Strain 19 in 260 infected herds, containing approximately 19,000 cattle. In the initial agglutination test applied to these herds, 29.2 per cent. positive reactors and 8.9 per cent. suspicious reactors were disclosed. The trial was completed on January 1, 1942, and the following summary is taken *verbatim* from the report dealing with the entire period January 1, 1936, to January 1, 1942.

> "Among the cattle vaccinated as calves up to January 1, 1942, 17,608 calvings occurred, involving 6 pregnancies. Of these, 9,526 were first calvings; 4,993 were second; 2,279 were third; 688 were fourth; 118 were fifth and 4 were sixth. There were 17,056 (96.9 per cent. of the total) that were normal calvings. Of these normal calvings 14,757 (86.8 per cent.) were negative to the test after calving; 677 (3.9 per cent.) were positive and 1,622 (9.5 per cent.) were classed as suspicious. Therefore 13.4 per cent. of the cattle that calved normally were classed as either positive or suspicious at the time of parturition or soon after. On the other hand, there were 552 abortions (3.1 per cent. of the total) among the cattle that calved during that period. Of this number 357 (64.7 per cent.) were negative to the test; 151 (27.4 per cent.) were positive; and 44 (7.9 per cent.) were classified as suspicious. Therefore on the basis of the blood agglutination test, only 195 abortions (1.1 per cent. of the total calvings) could be attributed to brucellosis."

In consequence of these trials, the Bureau of Animal Industry decided in 1942 to adopt calfhood vaccination as an aid to furthering its official policy of eradication.

Resistant, Disease-free Herds can be Built Up The method, when systematically carried out in conjunction with blood-testing, and with rigid adherence to measures of hygiene and disinfection, has much to commend it as a means, not only of control, but of eradication. Used in such a manner, it offers a practical, economical, and effective way of building up resistant, disease-free herds.

The isolation of calves after vaccination is contra-indicated, for, as has already been stated, any moderate infection with which the animals come in contact should reinforce the artificially induced immunity. (The question is often asked whether infection will be carried from a vaccinated to an unvaccinated animal. All the available evidence suggests that such transmission does not occur.) It should, of course, be borne in mind that while the basal protection is undoubtedly high, it probably falls as time passes, and in the absence of exposure to natural infection, the protection derived from a single dose of vaccine may, in the course of time, be insufficient to protect the animal against introduced heavy *Br. abortus* infection. Where, however, increased protection appears desirable or necessary, there is no reason why the original basic immunity should not be reinforced later by a further inoculation with one or other of the available vaccines, depending on the requirements of the particular herd.

Following vaccination certain reactions, local and general, may be seen. A hot, tense, rather painful swelling, varying in size, frequently develops at the site of inoculation. This, however, tends to disappear in from four to ten days. A rise of temperature may also take place, and the animal may appear listless and dejected, and have little appetite for some three days. It is recommended that all animals should be housed for three to four days after inoculation.

FLAKING PAINT IS DANGEROUS TO CALVES

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and
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LEAD poisoning produced by licking paint from old wood or ironwork commonly used in calf pens has recently been found to have caused the death of calves up to a few months old. That cattle care very susceptible to lead poisoning is well known, but the danger to which they are exposed by flaking paint is not perhaps so obvious, and therefore not generally realized.

Cases on Nine Farms The matter was first brought to our attention when we were called into consultation on the loss of calves by "fits" on three different farms. In each case it was noticed that old painted doors were being used as partitions in the calf pens.

Post mortem examinations of calves with a similar history, made during the past eight months from each of six farms, has enabled us, in all cases, to confirm our suspicion of lead poisoning by chemical analysis of the organs. The source of lead in each instance was old paint which was flaking off stall partitions and doors.

The time which must elapse between ingestion of paint and death is not known with certainty, and it is probable that the flakes are taken in repeated small doses. In one case death occurred a week after the animal had been removed from any possible contact with painted materials.

Usually the calves were found dead after previously appearing quite normal, but in some few cases others showed symptoms (lasting at most only a few hours) of bellowing, running in circles, staggering into walls, blindness and convulsions. In most cases it was possible to demonstrate blackened flakes of paint in the stomach contents, the blackening being due to the action of hydrogen sulphide formed in the fore stomachs masking the original colour of the paint. Chemical analysis has shown lead to have been present in stomach contents, liver and kidneys.

Experiment with Week-old Calf An experiment was carried out on a week-old calf by administering to it in a single dose by mouth one-third of an ounce of paint, scraped from one square foot of the surface of a door which had been used as a partition in a calf pen where deaths had occurred. The animal was quite normal until seven days later, when it suddenly developed a "fit": it bellowed, ran in circles, staggered into the walls of the pen, went into convulsions and died within an hour of first showing any abnormality. Ten minutes before death the rectal temperature was 112° F. The stomach contents were found to contain blackened flakes of paint. Chemical analysis showed lead in the stomach contents and internal organs in concentrations similar to those found in natural cases.

It should be noted that the symptoms in this experimental case lasted only an hour; but for the fact that the calf was heard bellowing, it would have been reported "found dead" at the next feeding time. This is in keeping with the history of "sudden deaths" not uncommonly given in natural cases of lead poisoning, where calves are found dead in the morning after having appeared in good health the night before.

The cause of the trouble is not always suspected even when the typical nervous symptoms are observed, and it is certain that more cases occur than are actually diagnosed.

Simple Precautions Losses of stock from this cause are easily avoided once the danger of flaking paint is appreciated. Any flaking paint on doors or fittings to which calves are likely to have access should be removed carefully and then creosoted. Although there may be other causes of "fits" followed by sudden death in calves, the possibility of lead poisoning should always be kept in mind.

PIGS ON THE FARM

Summary of Home Service Broadcast: W. S. Mansfield with Alex. Hobson, O.B.E., Secretary of the National Pig Breeders' Association, and Alexander McGuckian of Cloughmills, Co. Antrim - - - - - - - - March 9, 1944

MR. MANSFIELD opened the discussion by expressing the opinion that although the number of pigs has declined during the war, the number of pig-*keepers* has increased. There are fewer pigs on more farms, a readjustment which might well be developed further now and expanded after the war. Mr. Hobson and Mr. McGuckian agreed; the

proper function of the pig is to "tie-up" with general, mixed agriculture and to convert the surpluses and by-products of the farm into wholesome food.

Mr. McGuckian who was feeding 10,000 pigs annually in Northern Ireland before the war, mainly on imported food, would like especially to see breeding extended on small farms, because breeding is by far the most unsatisfactory side of large-scale production. There would still be a place for specialized fattening, inasmuch as millions of pigs are required by the trade ; and for Wiltshire bacon a standard product is needed.

The Larger Pig is More Economical

Mr. Mansfield thought public taste is changing and that after the war a more mature bacon might be preferred. Mr. McGuckian hoped so, for the small pig is much more costly to produce : it requires fine-milled foods, milk, etc., whereas the heavier pig will consume large quantities of potatoes and raw materials produced on the farm.

This pleased Mr. Hobson whose 130,000 pig club members are killing at much heavier weights than the 220 lb. live weight demanded by the curer before the war. They are using large quantities of swill from industrial areas, and it is the older and heavier pigs that can make the best use of it.

In Mr. Mansfield's opinion it would simplify the farmer's problems if the curers and the public would accept larger pigs. The Grade A pig was often an inefficient converter of the food it consumed ; and although the Grade B pig realized less per score, it paid better. The reason for this, said Mr. Hobson, is that the so-called "ideal" pig, that is, a pig with a thin back and a thick belly, was not a natural product. Mr. McGuckian, however, would not go quite all the way. In his view the pig is a very adaptable animal, and can be bred for nearly every requirement in reason. "We have improved our pigs enormously in trying to meet the demand for Wiltshire bacon," he said, "but I agree that extreme length in a pig must always tend to be at the expense of depth and constitution". The curer should give greater consideration to what is economical for the farmer.

Before the war Northern Ireland catered for the Wiltshire trade as well as the "roll and ham" trade. They had only one breed of pig, and pigs for the Wiltshire trade were slaughtered six weeks earlier. To encourage the production of the lighter pig, 6s. more per cwt. had to be paid.

Mr. Hobson then drew attention to the fresh meat aspect—an extremely important factor in our pig production problems : about 60 per cent. of our pigs were required for fresh pork before the war. A heavyweight pig is required with plenty of fat for the Midlands and a much smaller pork pig for the South.

Both he and Mr. Mansfield thought a one-breed (Large White) policy, as in Ireland, would not satisfy all requirements in England. Anyhow, we must have a sow that is prolific and a good grazer, and above all, a good mother. Mr. McGuckian said that there is a very strong feeling among some people in Northern Ireland that another breed is needed for crossing to get "hybrid vigour," but the curer is definitely opposed to the introduction of any colour. Mr. McGuckian's own view is that it should be possible to select within the Large White breed the strain which would give the requisite vigour and constitution.

Mr. Mansfield, having kept all sorts, prefers a coloured breed: he believes they are hardier. Mr. Hobson thought strain to be of greater consequence, although coloured pigs may be better grazers and certainly stand the sun better It was generally agreed that the fear of "seedy-cut" was over-stressed ; it is rarely found except in the pure Black pig.

Rearing Mr. McGuckian then inquired as to the method of rearing preferred. Mr. Mansfield likes to keep sows out-of-doors and on a tether when suckling. Mr. Hobson thought the electric fence is proving an even greater boon than the tether. In Northern Ireland, said Mr. McGuckian, there is a high rainfall (about 43 inches) and outdoor methods, though best as a rule, are impossible with large numbers. There is serious danger of disease, hence he prefers to rear pigs inside and run the sows out only during pregnancy. The little pigs, however, may suffer from anaemia and are treated with iron.

By and large, said Mr. Mansfield, it is a question of spreading the pigs—adjusting the number to the land available. Fresh ground is even more important for pigs than for sheep.

Litters On the question of litters, Mr. Hobson maintained that a sow ought to rear seven or eight twice a year, the pigs weighing 30 or 40 lb. at 8–9 weeks old. Mr. McGuckian paid a tribute to the pig stocks of the country: "the standard of merit is higher than the standard of management of the producer. Management breaks down much more frequently than breed. Pigs are too often only a side-line, and that is why on the family farm in Ireland labour to look after two or three sows is not the greatest problem ; it is finding a money return for the labour that is available". A "man unit" from a breeding point of view would be about 35 sows, and in such circumstances every encouragement should be given to an expert stockman.

Scandinavian Pig House Unsuitable Next, housing. Mr. Mansfield asked Mr. McGuckian if he is a believer in what is known as the Scandinavian type of pig house. "By no means," replied Mr. McGuckian, "I think the Scandinavian pig house was the wrong thing for this country. It may have suited Denmark, but if you've got to keep a lot of pigs together, the large community house under one roof is altogether the wrong idea. I like pigs always to have access to the open air and to have a warm comfortable place to sleep in." Mr. Hobson agreed that many such houses were "white elephants," although quite useful for storing potatoes and fertilizers ! Some of the best pigs he has seen were running in yards. Mr. Mansfield, although enjoying the luxury of one of the most elaborate Scandinavian pig houses at Cambridge, agreed that pigs never do better than in a yard with masses of straw and warmth.

In County Antrim, Mr. McGuckian said, they had designed houses so that one man could feed nearly 1,000 pigs—a long, low building subdivided into separate compartments, so that each group of pigs is isolated from its neighbour. A feeding passage runs down one side and the sleeping compartments along the other. From this, side doors open into outside yards which are largely covered with a wide verandah. Ventilation is always perfect, and the floors inside are always dry and need no cleaning for months on end. This appealed to Mr. Hobson as the kind of house which might be erected on the outskirts of big towns to make use of kitchen waste.

Pigs and Potatoes Mr. McGuckian had another idea: a centrally controlled enterprise to purchase potatoes from growers who would find the market for their crops through pigs. In the early days of the war he purchased thousands of tons from neighbours, and cooked and ensiled them. Throughout its life a pig can consume up to 1 ton of potatoes, which will replace 50 per cent. of its meal requirements. Assuming 10 tons of potatoes per acre, 10 pigs at £1 a score would return £100. If management is put at £25 and "offals" (meals) at £25 (5 cwt. per pig), there would be £50 for an acre of potatoes. After the war we should have to think of hundreds of thousands of acres in the West of England and Ireland, of low priced and less accessible land which nevertheless will grow bumper crops of potatoes. "I'm thinking," said Mr. McGuckian, "of people as well as money values, and also of the millions of pigs that we shall have to make up after the war."

VOLUNTEER AGRICULTURAL CAMPS IN 1943

ONE of the difficulties of making use of the services of townspeople who volunteer to work in agriculture is the shortage of accommodation in country districts. To overcome this difficulty a few War Agricultural Executive Committees have, ever since 1941, been organizing camps from which townspeople on holiday could work on the land. It was not until 1943, however, that the scheme for volunteer agricultural camps reached really large proportions. In that year volunteer agricultural camps were set up in 35 counties, and were attended by some 80,000 volunteers.

Preliminary Arrangements A great deal of preliminary work is necessary before a camp can be opened. First of all, the Committee has to consider the needs of the various parts of its county, the sources of labour likely to be available, and then to decide where, and for what period, the camp will be required. A suitable site with adequate water supply has to be found, and arrangements made for sewage disposal, etc. Equipment has to be ordered and staff engaged. Farmers have to be informed of the plans for a camp and arrangements made for organizing the work of the campers. At the same time, volunteers have to be enrolled, and this means extensive publicity and provision for the considerable clerical work involved in dealing with thousands of applications, arranging bookings, issuing railway vouchers, and so on. All these arrangements take some time to complete, and preparations have to begin months before the camp is due to open.

Last year, owing to the shortage of other accommodation, most camps were under canvas, although Government hostels, requisitioned premises, country houses, church halls and even, in one case, a castle, were used. Choice of site is governed by the need for accessibility to roads, water supply, etc., but all Committees took special care to select, as far as possible, a site in pleasant surroundings. Equipment for the camps was supplied by the Ministry of Works.

Camp Staff The appointment of camp staff presented one of the most difficult problems. The post of Camp Warden is a "key" one, and suitable men or women are not easy to find at this stage of the war. Securing cooks and domestic workers constituted another very real problem,

and Committees had many anxious moments with visions of hundreds of hungry campers and no one to cook for them. But fortunately cooks for all the camps were found ultimately, generally through local publicity or with the help of the Ministry of Labour, and no one went hungry. Local women were sometimes available to help with the domestic work, but at many camps it was necessary to ask each camper to do a short spell of messing duties. Actually, some campers preferred to spend their week on domestic work, which they rightly regarded as being equally valuable to the war effort, and Committees were very glad to use their services in this way.

Obtaining the Volunteers Some Committees started their publicity campaigns early in the year—the first camp opened in April—but the main appeal for agricultural camp volunteers did not begin until May, when detailed guidance was issued by the Ministry, including specimen posters, advertisements, and so on.

Two of the most prolific sources of volunteers were London and Manchester. To handle the large numbers which came forward from these towns, and to help them discover where their services could best be used, Regional Offices were set up in those centres by the Middlesex and Lancashire War Agricultural Executive Committees respectively.

Many business firms and factories arranged to stagger the holidays of those members of their staff who had volunteered to attend a camp, so that parties could attend in successive weeks. Such an arrangement greatly facilitates the work of running these camps. Some large firms went further and "adopted" a camp for a period, arranging to keep it filled with their own employees. Others gave an extra week's leave to their employees on condition that they were prepared to spend it working on the land. The Ministry is very grateful to the firms who co-operated in this way. Incidentally many firms reported that the health of their employees had greatly benefited from a week's work in the open air.

One of the main difficulties was to obtain a sufficient number of volunteers for potato lifting in the latter part of September and October. Perhaps not unnaturally, most volunteers wished to come to camp in July and August. Camps were quickly filled for these months, and many volunteers had to be refused. Special approaches were made to business firms to release employees during the autumn, and about 10,000 Civil Servants, who had volunteered for emergency harvesting, were released for a week's special leave during September or October. In spite of these efforts, almost all camps were short of volunteers during this critical period, and many had to be closed earlier than was either intended or desired.

Volunteers from Every Walk of Life The volunteers included men and women of every class and occupation—clerks, typists, shop assistants and income tax collectors, factory workers and miners, soldiers and airmen on leave, and men of the merchant navy awaiting their ships. They came alone, with friends or relations, and in large parties. Two-thirds of the volunteers were women, and ages ranged from 17 upwards.

The spirit of camaraderie in the camps was well marked. There were, of course, a few campers who did not fit in; for example, people who were determined, whatever the country's needs, to have a good holiday. Such slackers were soon detected, however, mainly by their fellow campers, and the general practice was to send the would-be holiday-maker back home and replace him by a genuine worker.

Volunteers' Payments and Earnings The instructions issued by the Ministry were that campers were to be charged the bare cost of their board, including the cost of food and the wages of camp staff, but that no charge should be made for accommodation and equipment, nor for the services provided by Committees. Volunteers were entitled to cheap railway fares, and an allowance was made to cover the cost of taking their bicycles to camp. In general, the board and lodging charge worked out at between 24s. 6d. and 30s. a week. The volunteers were paid wages by the farmers who employed them at the local time or piece rates. Men generally earned at least 1s. an hour and women 10d. an hour. Some energetic volunteers, used to hard work, took on jobs at piece rates and were often able to earn quite large sums.

The Work The work undertaken by campers included practically every type of market-garden work and harvesting operation, and it is gratifying to record that not a single complaint from a farmer has been received by the Ministry. Most farmers have, indeed, been more than satisfied with the standard of volunteers' work, especially those who made allowances for inexperience and gave advice and encouragement on the first day. Farmers showed their appreciation in many cases by paying a bonus at the end of the day ; and it is significant that the volunteers appreciated this, not so much for the money itself but as a token that the farmers were satisfied with their work.

Some Criticisms During the period that the camps were open a number of criticisms were received both by War Agricultural Executive Committees and by the Ministry ; indeed, constructive criticism was welcome, so that improvements could be made wherever necessary.

Many of the complaints related to matters that could be, and were, put right at once : others could have been dealt with had they been raised at the time. An astonishing amount of ingenuity was displayed by Committees in improvising and "making do" with such materials as they had at their disposal. One Committee, for example, which had difficulty in obtaining suitable partitions for tents and huts, found that admirable screens could be made with straw thatching : this was prepared very quickly in the Committee's thatch-making machines.

A number of complaints were from people who had imagined that conditions would be rather more congenial than in fact they were. It is true that in this first experimental year campers were called upon to rough it a good deal ; but most of them liked it. In many respects improvements will be made this year. The sandwich lunch also came in for a good deal of criticism. Most of the campers were people who were used to having a substantial meal at midday. Perhaps at some of the camps there was lack of imagination in devising sandwich fillings and alternatives to sandwiches. But it should be remembered that scores of thousands of regular farm workers are obliged to rely on a packed lunch at midday because there is no satisfactory way of supplying a hot lunch to workers in the fields. The campers had their main meal when they returned in the evening and were more than ready to do it justice.

Where 80,000 people of all ages and descriptions are concerned, complaints must be expected. But for every complaint made, there were at least ten letters expressing satisfaction ; and, what is more to the point, most of them promised a return visit late in the year or in the present season—and this despite the fact that the critic is more likely than the satisfied person to write a letter. On the other side of the picture, hundreds of farmers have expressed their gratitude for timely help.

FARMING NOTES

Horses as well as Horse-power Mechanization has loomed large in war-time agriculture, and it is unquestionable that without it our production of food would have been meagre indeed. But vital as is this mechanized arm, farm horses are still important —indeed, for certain jobs they are as indispensable to-day as when they were the normal form of motive power.

Hard-working farm horses do not always get sufficient variety of food. Oats and hay are, of course, the main basis of all horse-feeding, but even if both are of the *very* best quality (which is seldom) they do not form a complete ration. The mature horse can manage on them for months, but the way in which horses improve when turned out to grass in May or June shows that winter rations are to some extent deficient. The horse needs a little extra, and that little extra helps a lot. This extra can be 5 or 10 lb. daily of pulped or minced swedes or mangolds ; a couple of marrow-stem kales (minus the roots and lower hard, woody stem), a handful of cabbage leaves, 4 or 5 lb. of good silage, and if there are a few surplus carrots or parsnips, let the horses have them.

The Saturday bran-mash of peace-days is now practically only a memory, but a reduction of the heavy food (oats, beans, etc.) at week-ends or when the horse is idle, is just as sound as ever it was if "Monday morning disease" ("weed," lymphangitis) is to be avoided.

Regularity of feeding should be the watchword ; it does not matter so much *when* you feed so long as it is at the *same* time every day.

Nowadays, one frequently sees farm horses badly turned out—harness and horse both dirty, mud left on feet and legs, and so on. Of course, pressure of other work and shortage of labour are often to blame, but it must never be forgotten that such bad management usually goes with inefficiency and waste.

It is an axiom of horse management that a good daily grooming, properly carried out, is a form of skin massage and massage of the surface muscles : it stimulates circulation of the blood and lymph ; it encourages the excretion of waste products ; it gets rid of dead cells (scurf) and loose hair ; it disturbs and removes lice and their eggs ; and it gives the horse a polish and good appearance which advertises the efficiency and conscientiousness of the horseman and his master.

Menace to Brassica Seed Production The productive efforts of gardeners and market-gardeners cannot be fully successful unless there are available sufficient supplies of seed that is true to type. With cabbages, brussels sprouts, cauliflowers and kale, cross-pollination with other varieties is so common, and attended with such disastrous results, that every effort should be made to prevent it occurring in crops saved specially for seed purposes.

It is not sufficient to give special care and attention to the seed crops. The trouble often arises from old stumps left to run to flower. If you have not already done so, it is most important that these old stumps should be destroyed before they have a chance of flowering. The danger of contamination to seed crops of Brassicas can be largely overcome if all growers of cabbage, savoy, brussels sprouts, broccoli, kohlrabi, kale, swede and turnips will co-operate in destroying the stumps before they flower. This is particularly important in the intensive seed-growing area of Essex, where there is in operation a special scheme for the prevention of cross-pollination.

Routine Dosing of Lambs with Phenothiazine Minute worms in the stomach and intestines of sheep are responsible for heavy losses every year. Lambs 6–9 months old are most commonly affected, although animals of any age from a month upwards may suffer, and a large proportion of the flock is often affected at one time. Loss of condition in the early stages is followed by diarrhoea, which becomes increasingly severe and leads to great weakness and, not infrequently, death. A less severe form of attack is now known to be widespread and, in the aggregate, is probably responsible for a loss even greater than that caused by the more obvious form. It is unwise to wait until symptoms actually appear before commencing treatment, for damage and loss can be avoided by regular treatment.

The older remedies—bluestone, and a mixture of bluestone and nicotine sulphate—are of considerable value, but they fail to kill some kinds of the parasitic worms. Treatment with phenothiazine, the recently introduced drug, is much more effective, since it attacks a wider range of harmful worms and has the added advantage of being safer for the sheep. Phenothiazine is sold for use either in the form of tablets or as a specially prepared powder which can be mixed with water immediately before dosing.

Since worms are present wherever there are sheep, and since lambs, particularly at weaning time, are most susceptible to infestation, the routine dosing of all lambs with phenothiazine is strongly recommended; it well repays the cost and labour involved. Dosing should commence when lambs are 6 to 8 weeks old, and at this time the ewes should be dosed as well as the lambs, to prevent them from contaminating the herbage. Thereafter the lambs should be dosed every month until weaning time. Weaning is the most critical time for lambs, and dosing at this period should never be missed.

Poorly nourished sheep are more liable to attack by worms, and efforts should therefore be made to augment the feed in times of drought—particularly with lambs.

Advisory leaflet No.275, *Stomach Worms in Sheep*, deals with this matter in greater detail, and single copies may be obtained free on application to the Ministry's offices, Berri Court Hotel, St. Annes-on-Sea, Lancs.

Control of "Turnip Fly" Every year there is a sad story to tell of the depredations of the turnip flea beetle (commonly known as the turnip fly). Not only turnips, swedes and the various members of the Brassica family are attacked, for there are many species of flea beetles of differing habits: in some seasons mangolds, beet, barley, hops and even potatoes may suffer. The main danger is at the seedling stage, and it should be remembered that the beetles begin their attack just before the first leaves appear above ground, continuing until the rough leaf is produced. Indeed, given a dry, warm spring, the plants may be destroyed before there are any signs of growth at all.

As with all other forms of pest control, the emphasis is on prevention. Seed is sometimes dressed with paraffin or some other liquid repellent, but this is by no means as reliable as spraying the seedbed with an insecticidal dust as soon as it is thought germination has started. The dust can be bought ready for use and applied with a "dry sprayer" knapsack or horse-drawn dusting machine, whichever is the more convenient. Subsequent applications at intervals of about five days may be necessary if the attack is renewed.

A short description of the most common flea beetles and their life history, together with recommended methods of control, is contained in

the Ministry's Advisory leaflet No. 109, *Flea Beetles*, which will be sent free of charge on application to the Ministry's offices, Berri Court Hotel, St. Annes-on-Sea, Lancs.

Appointment of Professor Rae as British Agricultural Attaché at Washington and Agricultural Adviser at Ottawa

Professor James A. Scott Watson, M.A., who for the past two years has been Agricultural Attaché on the staff of His Majesty's Ambassador to the United States of America, and Agricultural Adviser to the High Commissioner of the United Kingdom in Canada, will shortly be returning to this country. He will be succeeded by Professor Robert Rae, B.Agric.

Professor Rae is professor of agriculture at the University of Reading, a member of the Board of the National Institute for Research in Dairying, and has been prominently associated with the work of the Berkshire War Agricultural Executive Committee. He will be no stranger to the United States, for he visited that country in 1943, at the invitation of the U.S. Department of Agriculture. He travelled widely, visiting agricultural colleges and farming conferences speaking on British agriculture in war time.

Fruit Spraying Charts: Use of Lead Arsenate for Apples

Last autumn the Ministry issued two charts depicting in natural colours the chief stages of fruit bud development in fruit trees. One chart dealt with apple and the other with pear, plum and black currant; and each stage illustrated was given a standard name, as for example, Pink Bud, Petal Fall and Fruitlet. One object in issuing the charts was to help growers to choose the best times for carrying out the spraying operations that are so necessary to secure the maximum output of fruit under war conditions.

Below each illustration brief comments were made about the use of certain sprays. On the Apple chart the addition, if necessary, of lead arsenate to lime sulphur was recommended at the Green Cluster, Pink Bud, and Fruitlet stages. One correction to this has, however, become necessary because in certain districts, and especially in Kent, there is a risk of spray damage if lead arsenate is added at the Fruitlet stage to lime sulphur at 1 in 100 or weaker. Commercial growers who already have copies of the *Apple* chart are therefore advised to delete the reference to the use of lead arsenate at the *Fruitlet stage*. The recommendation to include lead arsenate, when necessary, at the Green Cluster and Pink Bud stages remains. Those who have not yet applied for copies of the two charts can obtain them in amended form, free and post free, from the Ministry's offices, Berri Court Hotel, St. Annes-on-Sea, Lancs. It is regretted that the charts cannot be supplied to the general public.

Potatoes and Black Currants: Certification

With a view to the continued improvement of stocks of potatoes and black currants, the Ministry has again made arrangements this year for the certification of growing crops. Application forms are being sent to all growers who entered stocks for inspection last year, but other growers who wish their stocks to be examined should apply (preferably by post-card) to the Ministry's offices at Berri Court Hotel, St. Annes-on-Sea, Lancs. for the relevant memoranda and application forms. A separate application form must be completed for each farm, and must reach the Ministry not later than June 16, 1944, (for potatoes) and June 1, 1944 (for black currants).

NOTICES OF BOOKS

American Dairy Cattle: Their Past and Future. E. Parmalee Prentice. Harper & Bros. 1942. 15*s*.

The European as well as the American history of the six dairy breeds—Holstein-Friesian, Milking Shorthorn, Ayrshire, Guernsey, Jersey and Brown Swiss—is traced by means of contemporary writings and illustrations, and there are many references to and quotations from the original literature. The details of these are both complementary and otherwise, and will, no doubt, give rise to much discussion in breed circles. There is much to be learned from the facts given in this valuable work. Through the Middle Ages the cattle of Europe were in a state of semi-starvation, and it was only with the discovery of the effect of good feeding that the improvement of cattle in Britain began. This improvement was first shown in beef, for at that time it was meat rather than milk which paid best; milk was a by-product of the beef industry. It was only following the discovery of the effects of feeding that people began to study methods of breeding; the method adopted was to breed best to best. Pure breeding of dairy cattle did not begin until the introduction of the herdbooks, which, for the dairy breeds, were first started in America and adopted in the course of a few years in Europe—over seventy years ago. While these herdbooks kept the breeds pure as regards colour and type, the mere registration of ancestry and inspection could do little or nothing to improve production: it became obvious that other action was needed. The various steps taken by the different Breed Societies in America to improve the production of their breed are outlined. While, for example, with the Jersey registration of ancestry only was required at first, there were introduced in succession, the Register of Merit (for production), the Herd Test (all cows in herd recorded), Tested (Proven) Sires (10 or more daughters), Tested (Proven) Dams (3 progeny), the Star Bull Scheme (summary of accomplishments of ancestors of a young bull), and eventually Selective Registration, i.e., Registration only if production is satisfactory.

The progeny testing of bulls, as exemplified by the Mount Hope Index, is considered essential for progress; it is estimated that dairy cattle breeders, by the use of sires of good index, can increase the average production of herds which average under 400 lb. butter-fat per cow per year by 30 to 50 lb. in the first generation, and afterwards by about 15 lb. per generation. Some idea of the progress made in increasing milk yields is shown by the gradual increase in the "record" yield of cows in the Holstein-Friesian breed—from 12,681 lb. milk in 1871 to 19,714 lb. in 1884, 30,651 lb. in 1914, and 38,606 lb. in 1936. The problem of raising the general level of milk production of the average cow is now being undertaken by the American Dairy Cattle Club; individual producing and transmitting ability is the basis of its recording system, the details of which are outlined. The book is well worth reading by all breeders of dairy cattle.

Pasteurization. Harry Hill. Lewis & Co. 1943. 10*s*. 6*d*.

As the joint author of *Milk Production and Control*, Mr. Hill is already well known to many connected with the dairy industry. It is appropriate, therefore, that he should now appear as the sole author of a practical text-book on pasteurization, particularly as the subject has been given greater interest by the publication of the White Paper, *Measures to Improve the Quality of the Nation's Milk Supply*.

Mr. Hill is a strong supporter of pasteurization as a public health measure, and the opening chapters deal simply and logically with the evidence in favour of the process and its effect on the keeping quality and nutritional value of milk. He proceeds to deal with methods of pasteurization in common use, with special reference to the High Temperature Short Time and "in-bottle" systems. Brief descriptions of ancillary equipment and methods of cleansing are included, together with the control measures which are necessary to ensure that the process is carried out effectively.

In spite of the absence of illustrations and diagrams, the book should prove of value, not only to dairy managers, plant operators and milk control officials, but also to students of dairying and to interested members of the general public.

Agricultural Reconstruction: The Land and its Equipment. The Land Union. 1943. 1*s*.

The aim of this booklet is to show how landowners can help in the maintenance and development of the land and its equipment after the war. The landlord-and-tenant system is thought to be fully worthy of retention, as being the best for agriculture, and arguments against land nationalization are adduced.

The proposals made cover housing, water supply, electricity, drainage, and the provision of credit at low rates of interest for building purposes. Measures to promote the conservation of soil fertility, the encouragement of modern methods of cultivation, the consolidation of holdings into economic units, and forestry are discussed; changes in taxation to benefit agricultural land are also advocated.

The brochure declares that if the suggestions which it incorporates are adopted landowners will be able to maintain and improve agricultural housing conditions and the equipment of estates more expeditiously, efficiently and economically than would be possible if the land were nationalized, while the benefits derived from their personal interest in the estates would be preserved for the nation.

Die Soja. DR. AD. HUEBSCHER. A. NIEDERHÄUSER A. G., Grenchen, Switzerland. 1943.

Dr. Huebscher is a soya enthusiast, and his main concern is to stimulate interest among Swiss farmers in the cultivation of soya beans as a home-grown source of oil and protein. The book, which is written in German, contains a detailed account of the botanical, agricultural and nutritional aspects of the crop. Of particular interest is the section dealing with the use of soya beans in the human dietary, for the protein of this leguminous grain is being used extensively to supplement the diminished supplies of animal protein for human beings as well as for animals. Several attractive soya bean dishes for the family table are described.

The Education of the Countryman. H. M. BURTON. Kegan Paul. 1943. 15*s*.

Mr. Burton's book is an attractively written account of the all too gradual development of rural educational facilities. He shows how serious has been the neglect in this sphere of the education service and pleads ably for a more enlightened attitude on the part of the authorities, so that the country-born child may not be at a disadvantage in comparison with his urban brothers and sisters. The suggestion is made that the curriculum of the re-organized school should be less academic than formerly, provide training in handicraft subjects, with particular reference to rural pursuits and by means of the school estate impart instruction in agricultural practices. The author claims that re-organization along these lines will firmly establish a life-long interest in the rural world and stem migration to the towns.

Great stress is laid on the importance of the Service of Youth, which has made big strides during the war. Mr. Burton foresees that this may play a leading part in rural districts in fitting the children to appreciate the wider aspects of national life.

To provide technical education for those who aim at responsible posts in agriculture, Mr. Burton would make the fullest use of the agricultural colleges and farm institutes. At the same time he urges the establishment of many more of these centres and a wider practical instruction in crop and animal husbandry.

Mr. Burton clearly appreciates the need for a closer relationship between education in the countryside and the needs of agricultural and rural life, and more generally, for a better understanding between town and country folk.

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AMERICAN JOURNEY

E. WATSON JONES

The author, who farms 2,500 acres in Shropshire and Staffordshire, accompanied the Government's goodwill mission to the United States last year as the representative of British farmers. His impressions of American farming practice will be read with interest.—Ed.

IN the days before the war it was always a delight to take a "busman's holiday" and explore farming methods in other parts of our own country. What a wonderful experience, then, for a farmer to travel, as I did, for over three months through many of the eastern and northern States of America, to the Middle West, and thence to the Gulf of Mexico, on a tour of farm inspection, meeting many of the leading farmers and visiting Agricultural Colleges throughout the country. I found many things from which we could learn something and realized that many preconceived ideas of American farming were entirely wrong.

Very largely, the United States is a country of family farms. With the exception of the great cattle ranches of the Middle West and the great wheat-growing areas of Kansas and neighbouring States, the farms are of moderate size, running generally to about 160 acres. Labour difficulties are acute, and one hired man on a holding of 200–300 acres is all that a farmer expects to obtain; consequently, expansion beyond the capacity of the family labour is a matter for careful consideration.

Dairy Farming in Pennsylvania Dairy farming predominates in Pennsylvania and throughout the Eastern States close to the large cities. This is probably the most interesting aspect of American farming. Farmers' Co-operatives hold a fair share of the milk business, and all the milk is sold on the basis of butter-fat content. The standard is 4 per cent., and price adjustments are made for milk above or below that standard. Retail milk prices in each city are fixed by a State Board, to which representations can be made for either raising or lowering prices. Suppliers to one of the largest Farmers' Co-operatives were, in June, 1943, receiving about 2s. a gallon for their milk. There is less variation between winter and summer prices in the U.S. than in England.

The breeds of cows are mainly Guernsey, Ayrshire, Jersey and Friesian. Dairy farmers do not favour dual-purpose animals; they breed entirely for milk. Considerable progress is being made with artificial insemination, often on a co-operative basis, using bulls that have been proven for milk production. It is found that 50 per cent. of the bulls chosen on pedigree or appearance prove to be unsatisfactory in test when the records of their daughters are compared with those of the dams.

The most important feature of American dairy farming is the campaign to eradicate disease amongst the herds. Tuberculosis and contagious abortion have been dealt with on a national basis, employing periodical tests of all herds and compulsory slaughter of reactors, for which compensation amounting to about two-thirds of the value of the cow is paid to the farmer. No dairyman will buy milk unless an annual test is made for tuberculosis and contagious abortion, and in spite of this the general supply to the cities is pasteurized. The consumption of milk in the United States is much higher per head of population than in this country. In winter the cows are fed largely on silage, made chiefly from maize which is chopped and blown into tower silos.

The farm buildings are of timber structure and consist of a large barn arranged, for the sake of labour economy, with grain and fodder storage above the cattle-stalls. Every farm is equipped with a good water supply—usually pumped by windmill—a circumstance which may help in the control of disease. A good, well-equipped dairy farm of 160 acres costs from £60 to £80 per acre, and good quality land generally is no cheaper in America than in this country.

Mixed Farming in Illinois and Iowa Further west, in Illinois and Iowa, is some of the best farm land in America—deep, black loam soil. Here there is mainly a mixed type of farming, with about 80 per cent. under the plough. The chief crops are maize, oats, lucerne and soy beans. If only we could grow maize as they do in this part of America, we should solve some of our feeding problems. The growing of this crop has been completely mechanized; it is sown in rows 36 in. apart and spaced for cross-cultivations with a tractor. At harvest time the cobs are stripped by a harvesting machine and stored in specially constructed sheds. A good yield of the grain is 40 to 45 cwt. per acre. Hemp for rope-making is a new crop, introduced only last year, and factories are in course of erection for dealing with the crop.

Throughout the United States the numbers of live stock of every kind have increased since 1940, and are fast going beyond the present supply of feedingstuffs; the pig population has increased by over 100 per cent., and I heard more complaints of feed shortage from farmers in Iowa than we get at home. In Iowa, pigs are kept out-of-doors on practically every

farm, being fed cheaply and simply on maize in the cob, with protein supplement provided in dry feeders. On many farms, it is the custom to "hog down" a portion of the maize crop, a practice which consists simply of folding pigs on growing maize in the autumn. It has the obvious advantage to the American farmer of saving labour, and, incidentally, it is more profitable than harvesting and selling the maize; bacon pigs fetch about 15s. per score live weight, and maize about £8 a ton.

Mechanization in the Middle West The Middle West farmers are mechanically minded; most of their work is done with tractors. Where horses are used, they are of a good quality Belgian or Percheron type. Many mules are also seen. Combines are used extensively throughout the Middle West, but in other districts they are less common and the binder is still in use. The bulk of the threshing is done out of the stook, as the weather at harvest time is more reliable than in England and three or four weeks can be taken to complete the threshing. The American peg-type drum has a greater capacity than our machines and also threshes with about half the number of workers; the straw is blown some distance away, where it is frequently burnt. Alternatively, the machine is set outside the barn and the straw blown into the top for convenience of handling as litter or fodder. Farmyard manure spreaders are found on every farm, and occasionally I saw a grab-type manure loader on the front of a tractor for filling the manure spreader. Americans are astonished at our patience in handling farmyard manure so many times with a manure fork! Pick-up balers are used on many farms, also pick-up choppers for lucerne or clover, which is chopped and blown into a trailer for subsequent storage and winter use. Fertilizer placement is considered important, and combine drills for grain-sowing abound.

Erosion Problems The great wheat-growing areas of the Middle West have a farming system of their own which is entirely regulated by the moisture supply. Here the rainfall is so low, often about 15 in. or less annually, that in some areas moisture can be conserved only by cropping and fallowing in alternate years. This is the area of the "Dust Bowl," which has constituted a problem for a good many years; it has been settled and abandoned on no less than three occasions since 1880. It consists of light, red soil which "blows" easily during a dry period, but through the excellent Soil Conservation Service, this problem of wind erosion is now being tackled on sound lines. The area is again growing crops, and the farmers are learning the value of suitable crop rotation, and introducing lucerne which has great soil-building qualities. In some areas ploughs are being discarded; only discs or other special implements for sub-surface cultivations are used, and the stubble mulch is always left on top. New drills are being designed to sow on this stubble without blocking the spouts. By this method, loss by evaporation and by surface "run-off" is controlled.

Water erosion is another great problem all over America. Rainfall, when it occurs, is often extremely heavy; two or three inches of rain will sometimes fall in a night. Wherever soil is exposed on even slightly undulating land, severe surface washing and the formation of gulleys result. The remedy is contour cropping, perhaps better described as strip cropping following the contour of the land. In more serious cases mechanized terracing on the contour to prevent the quick flow of water is carried out. These remedies add to the cost of growing crops, but experience has proved them essential in this region.

Cattle Ranching The great cattle ranches of the United States extend through the Middle West wherever the land is not suitable for arable farming, and a single ranch may be anything from 1,000 to 100,000 acres. The natural grasses on these ranches do not appear particularly good to an English farmer, being brown and burnt in the summer; but their feeding value (up to 18 per cent. protein in the dry matter) is sometimes high. Hereford cattle predominate, and the ranchers of America are to be congratulated on the very great improvement which they have made over the last 50 years in the quality of their cattle from the big-boned Texas Long Horn. By using good Hereford bulls, they are breeding some of the best short-legged, good-topped beef cattle I have ever seen. Stocking is very light—one steer to eight acres, or one cow and a calf to ten acres. This is important; for if the land is bared early in the season it will burn up in a drought period. It must be said, however, that the cattle do extremely well.

Great progress was made in supplying water to these large areas of grassland during the depression years. With the assistance of the government, "unemployed" labour was set to dam the streams to form large lakes. To-day cattle are always within walking distance of a water supply. Many of the ranchers live 15 miles from their nearest neighbours, and those that I met I thought really fine men.

I spent a day on a ranch of 42,000 acres in South Dakota. Of this, 400 acres were arable, growing oats, maize and winter food for the cattle, and over 41,000 acres were under grass, which was divided by three strands of barbed wire fencing (over 120 miles long) into seven fields. Seven cowboys looked after the total stock of 50 horses and 3,500 cattle, about 1,000 of which were breeding cows. Every autumn the rancher sells his rear of cattle at about 18 months old. Sales are made privately by live weight on the ranch, and a large weighbridge has been installed. These cattle are bought for finishing on arable farms in the plough districts. The ranchers were making 65s. to 70s. per cwt. last autumn, leaving a fair margin to the feeders, since best quality beef killing out at 60 per cent. was making 80s. to 82s. 6d. per cwt. at the large packing stations. All sales of store and fat cattle and also store and fat pigs are by live weight; American farmers do not place any trust in an *estimation* of weight!

Irrigation in Colorado Extending east from the Rocky Mountains in Colorado, lies a large area of land at between 4,000 and 5,000 ft. and irrigated by gravitation with the melting snow from the Rocky Mountains. Great ingenuity and a lot of hard work have resulted in a constant flow of water, which is brought down sometimes naturally, sometimes by canals or tunnels following the contour of the land and feeding water-courses for irrigation by hand over all the land. Twelve to fifteen inches of water are usually applied during the growing season. Crops in this area are sugar beet, potatoes, wheat and barley, and the yields are about three times as much as the yields obtained in the dry areas already mentioned—wheat and barley at 30 cwt. per acre and potatoes and sugar beet at 16 to 18 tons per acre. In the very dry areas fertilizer is of little use, as the controlling factor in crop production is moisture. Here, with irrigation, fertilizers are applied, and this combination has trebled the yield. In considering America's future possible production, irrigation is an important factor, since it can be extended very considerably by river dams (this is also being done for flood control) and by pumps in some districts.

Sugar beet is grown by methods very similar to our own—drills 18 in.–20 in. and the plants spaced about 12 in. apart. It was interesting to find that the use of sheared seed is extending; with light seeding, it is evident that sheared seed gives a more evenly interspersed plant, which facilitates chopping out and thinning. One small farmer with 40 acres of irrigated land which I visited had 15 acres of excellent beet which he and his wife had chopped out and thinned without any help. I thought his yield would be quite 18 tons per acre. The price of sugar beet is from 55s. to 60s. per ton of washed beets for 16 per cent. sugar content at the collecting depots to which the farmer has to deliver.

Potato-growing in Maine Potatoes are grown extensively in Maine, one of the New England States. Here very few live stock are kept, and the farms are mainly on a three-course rotation—clover, potatoes and oats; the clover is generally ploughed in to enrich the soil for potatoes. Potatoes are planted in ridges 33–36 in. apart, a two-row mechanical planter and combine fertilizer sower being used, and as much as 20 to 25 cwt. of fertilizer mixture is applied. The sets are planted only 10 in. apart, and cut seed is favoured. Inter-row cultivations by tractor follow, and no hand work is done in cleaning. Dry spraying is carried out three or four times during the season, and two-row elevator diggers are favoured for lifting. The lifting season is short, as the potatoes are not ripe enough until mid-September, and by mid-October frosts may do damage; thus everyone available in the countryside turns to picking. The potatoes are collected and put into barrels holding 160 lb. by piece-work labour at 6d. per cwt. On one farm which I visited 14 men picked 50 tons of potatoes in one day. The sample seemed good, and the yield was about 10 tons to the acre. Owing to the very severe winters in this area, clamps cannot be used in the open; very elaborate store houses, partly in the ground and with insulated walls and roof, have to be built. Usually they are situated near a railway, even if it is as far as seven or eight miles from the farm. In these the potatoes are stored 18–20 ft. deep, often ventilated by air pipes running through the store. Such storage problems add very considerably to the cost of growing potatoes, and the price of ware is in the region of £12 to £13 per ton.

Agricultural Research Each American State has a large, well-equipped Agricultural College standing in several thousand acres of ground. Each of the counties in the States has a County Organizer who works under a Director stationed at the State College. This system provides a very good technical service to American farmers, and advice is eagerly sought. It was interesting to find agriculture being taken as a subject in the High Schools.

The Agricultural Adjustment Administration There is no compulsory food production programme in America, but encouragement is given to increasing production of those crops which are essential for the war effort; these are chiefly soy beans, wheat, potatoes and vegetables. What is called "Agricultural Adjustment Administration" has been established, with headquarters in each State, and also in each county. This Administration was set up in the New Deal in 1933 to adjust the production of crops to market requirements. Until the outbreak of war it curtailed the production of maize, wheat and cotton and other crops of which there was then a surplus, by planning cropping programmes which included lucerne and by encouraging sound crop rotations. These programmes were permissive, but farmers

who adopted them received financial assistance, such as an acreage payment on the lucerne and a subsidy on the application of lime. The Agricultural Adjustment Administration is now working to encourage the production of those crops which are more urgently required, while still maintaining the sound rotational cropping practice, and providing financial assistance to those farmers who adopted the allotted programme.

American farmers were more greatly affected by the depression of 1930 to 1933 than we were. In 1933 the "Farm Security Administration" was instituted to deal with the problem of large areas of the poorer land where bankrupt farmers and their destitute families were suffering as a result of malnutrition and lack of medical attention. In some areas these impoverished families were evacuated, rehabilitated on better soil and provided with the necessary credit, advice and assistance.

Under present conditions American farmers are reasonably prosperous, but I could detect no greater financial advantage compared with our own conditions. The price of good land is no less than here; farm workers are paid about £6 per week, but have no allotted hours. Machinery prices are slightly lower than ours, and the prices of their produce, with the exception of potatoes, are comparable. We may sometimes complain about our weather, but the American farmer has customarily to contend with extremes of drought and floods, with hail-storms which are disastrous and have to be insured against, with wind erosion in some dry areas and water erosion wherever the land is undulating. Fortunately we are spared these inclemencies.

STOCKING OF LEYS

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THE general adoption of a four-year plan for ploughing up remaining old pastures and replacing them by young leys will add materially to the stock-carrying capacity of the country as a whole. This increase will apply not only to the grazing season, but also to the winter, because the new leys give more and better hay, and because the tillage land resulting from this system of farming will yield heavier crops of roots and cereals for winter feeding. From this, it does not follow, of course, that every young ley is superior to every old pasture. Leys sometimes fail to establish themselves, or may be ruined by poaching in wet weather; in such instances a high stock-carrying capacity cannot be expected. Again, some old pastures are highly productive. Thus at the College Farm, Aberystwyth, an old pasture has maintained rather more than an average of one cow to the acre from the middle of April to the middle of November, while at the College Farm, Bangor, an old grass field has kept four Welsh ewes, each with one lamb, and one yearling heifer, to the acre. But in spite of failures that may occur in the establishment or management of leys, and notwithstanding occasional records of high production from old pastures, it is beyond dispute that the replacement of the old pastures by new leys will lead to a substantial increase in stock-carrying capacity.

More Stock Regarded from a national standpoint, as against that of the individual, the problem of where to find the extra stock is difficult, but not insoluble. Many of the bull calves at present being slaughtered would be suitable for the better pastures, and although it is true that a large proportion of these animals incline too much to the dairy conformation, there is, nevertheless, a great number that would make useful steers.

We are very apt to omit sheep from our calculations, to forget the good use they make of young leys and, what is now very important, the quick turnover they give. The reduction in the total number of sheep by just over 21 per cent. does not give a true picture of the situation as it affects the stocking of our new leys. The numbers of mountain sheep are about the same as pre-war, while the lowland flocks, both grass and arable, have been reduced to a much greater extent than would be indicated by the figure of 21 per cent. Thus the mountain flocks, the great reservoir for the grass flocks, are once more in a position to resume supplies, after having had an opportunity of making up the losses of three hard winters. The Hill Sheep Subsidy, by encouraging hill flockmasters in the replenishment of their flocks, will have played its part in the stocking of the new leys.

Better Stock Not only are greater numbers of cattle and sheep needed, but they should be better bred and thus give a better return for the nutritious grass and hay. Physiologists tell us that on a low plane of nutrition it is difficult to differentiate between the good and the bad doers, but that when the level of feeding is raised differences in the thriftiness of the animals become manifest. In other words, the need for well-bred stock will be more urgent on the new leys than on the old unproductive pastures. If effort is devoted to improving the grazing and hay land only, without a parallel effort in the direction of breeding, farmers will deny themselves the full fruits of their labours. Low-producing stock will be out of place on the new leys.

Cattle Young leys will not only maintain a greater head of stock, but they will enable each animal to produce more meat or milk than will an old grass. It is sometimes claimed that old pastures are superior to leys for milk or beef production, but such statements are never accompanied by supporting data. Occasionally there are old pastures of high productivity, but the yield per acre of milk or meat would probably be higher still if the same land were under ley.

Reference was made above to the high stock-carrying capacity of an old pasture at the College Farm, Bangor. In the absence of further figures it might have been assumed that there was no room for improvement. Further figures are, however, available, and these show that a temporary pasture on the same farm, over an average of 9 years, produced 35 per cent. more liveweight increase than the highly productive old grass referred to. On certain occasions there may be circumstances in favour of an old pasture ; all old and established systems can claim something in their favour. In a wet autumn, an old sward suffers less from the trampling of cattle and if it is badly matted, it will even benefit from such treatment. Again, we have often heard of the usefulness of the rough grass that is often found on old pastures in winter. When cows and young cattle are turned out for a couple of hours each day, such growth is useful. These tufts of rough grass, however, must be viewed in their proper perspective, when it will be realized that they are an indication of a sward of low productivity.

Sheep With farmers compelled to make a living in the best way they could, the land had tumbled down to grass. Sheep then became associated with the decay following the abandonment of the plough. There are some who were so impressed with that aspect of the grass flock that to-day they are blind to the role that sheep can play in well-balanced farming.

Mixed grazing is essential for soil fertility, sward management, and healthy live stock. Those who have embarked on a policy of intensive cattle production are fully alive to the dangers from intestinal worms, which arise especially in young cattle when they are too thick on the land. It is true that new vermicides have brought fresh hope in this direction, but it is equally true that the prevention of parasites by balanced farming is always superior to dosing.

The grass flock is almost self-adjusting in regard to the seasonal growth of grass. As the grass grows the lambs also grow, reaching their greatest weight when the herbage is at its maximum. The decline in the growth and nutritive value of the grass coincides with the sale of fat lambs, so that the pasture's burden is lightened at the appropriate time. Much of the advantage of the grass flock to the ley and of the leys to the flock is lost, however, unless the ewes are given supplementary feeding from lambing time until the grass commences to grow. Mangolds are probably the best food for this purpose ; the crop yields heavily, it is highly digestible, and—what is of great importance to the older ewes—mangolds are soft and easily scooped. One acre of this crop per 100 ewes will provide supplementary feeding for two months and will enable the ewes to yield sufficient milk for the lambs to thrive as they should. The sward is not punished so heavily as it would be by an ever-hungry flock dependent entirely on grass, and it also receives benefit later, because the satisfactory flow of milk induced in the ewes results in lambs being ready for drafting to the butcher by the time the growth of grass slows down in June and July.

This helping out of the ley during the two months preceding the spring growth of grass brings also an indirect result of great value. It is well known that the creeping thistle, the most expensive weed of grassland, is generally found where there is a grass flock, and many interesting theories are offered to explain the connexion. Recent research has shown, however, that the thistles are a result of the hard grazing in March and April. This weed is unusually sensitive to competition from other plants at that time of the year, and if the sward is grazed bare the thistle is provided with ideal conditions. The provision of additional food for the flock, and the lightening of the burden of the leys, is a helpful approach to the thistle problem.

Many thousands of grass flockmasters suffered increasing losses from what was regarded as an inevitable state of affairs in this enterprise—namely, a proportion of culls at the end of the season which would have to be kept on perhaps until the following spring. As the proportion of land under the plough declined and the farmer became more dependent on sheep, the number of culls increased. This increase was so great that in some cases the grass flock ceased to be profitable. Again, in some instances, not only did the lambs fail to thrive, but many became emaciated and died. I have known a large flock with as many as 50 per cent. of culls, including 10 per cent. lost through a condition variously described as "pining," etc. One aspect of the cull problem is being tackled by co-ordinated experiments under the aegis of the Agricultural Research Council. It may be noted, however, that while we do not know the cause or causes of this trouble, it

does not occur on new leys. Alternate husbandry will mean not only more stock per farm, but also better thriving sheep and a quicker turnover. Culls, the greatest source of loss from the grass flock, should cease to be a problem under ley farming.

Careful Management will Keep the Ley Young It would however, be a mistake to think, that once a ley is established no further skill or effort will be needed. Leys respond to skill and care in management. One can go so far as to state that with appropriate management a ley can be kept young. A sward properly managed can be maintained for a period of 10 years without losing much of its initial productivity.

To get the best out of ley farming the stocking must be managed with the same care and skill that are bestowed on the famous Market Harborough pastures. Overstocking in March and April and understocking in May and June bring about deterioration, the former punishing the early-growing perennial ryegrass too hard, and the latter encouraging bent and Yorkshire fog. The avoidance of turning out to grass too early in the spring has been one of the stock-breeders most difficult problems for the past generation. We have been able to recognize, admire, and envy the skilful and successful grazier who has always been able to wait until the sward had made a good start. His neighbours knew that it was the right thing to do, but they never seemed to have sufficient winter food to feed their cattle indoors for another fortnight. The secret of turning out cattle at the right time is to plan one year ahead, so as to provide an adequate quantity of food for early spring as well as for winter. Here again the value of the mangold crop must be emphasized; it helps to protect pastures at this critical time of the year, both from sheep and cattle.

There is one practice in particular that we could profitably imitate from the skilful husbandry of the Leicestershire pastures—the scattering of droppings at frequent intervals. This prevents roughness and deterioration at some spots, and stimulates others. The more fertile the land and the more dense the stocking, the more necessary does this become. Harrowing should also be practised, since this does much to freshen the pastures.

AGISTMENT OF CATTLE ON IMPROVED UPLAND GRAZINGS

MONTGOMERYSHIRE SCHEME

W. Ellison, Ph.D.

Montgomeryshire War Agricultural Executive Committee

In Montgomeryshire, as throughout Wales and the West of England generally, there are large acreages of grazings at elevations of 800–1,800 ft. above sea-level. Many of these areas are reasonably flat and tractable, and have a good depth of soil, but they are low in productivity and covered with the poorest of grasses, bracken, gorse or heather. The experiences of the last three years have, however, shown clearly that such areas when ploughed, adequately dressed with lime, phosphates and nitrogen, and reseeded, can be very greatly improved in productivity; further, the growing and grazing season is considerably extended at both

ends of the season. The Montgomeryshire War Agricultural Executive Committee has now nearly 3,000 acres of reseeded uplands available for grazing, and other County Committees with similar land under their jurisdiction may be interested in the scheme which the Montgomeryshire Committee has adopted to stock these areas and the experiences which were gained during 1943.

Under its scheme the Committee is prepared to accept all classes of healthy cattle over one year old, excluding bulls, for agistment on to approved reseeded upland areas at a rate of £6 per head for a period of five consecutive months. (£3 per head will be refunded for cattle that qualify for the Hill Cattle Subsidy.) For these charges the Committee undertakes to provide keep for and supervision of the cattle for the period of agistment. The owner is responsible for getting the cattle to and from the grazing areas.

Extra Grass Keep and The Dairy Farmer The work of reclaiming upland areas can be justified only if it is going to result, either directly or indirectly, in increased food production. On most of the reclaimed areas potatoes have been grown prior to reseeding. Cereals have also been tried, but by reason of the situation, elevation and high rainfall of these upland areas, many handicaps are presented to satisfactory corn-growing. On the other hand, they are admirably suited for better grass. The lowlands and valleys, with their higher temperature and lower rainfall, are much better suited to cereal-growing, both for human consumption and winter food for live stock. Dairy farming is of primary importance in the county; many of the herds are self-contained, in that they rear their own replacement stock. Moreover, since the Committee has adopted a policy of ley farming and ploughing round the farm, very many farmers are finding that they have reached the stage where the area of tillage (40 per cent.), even though growing priority crops, will provide food for more cattle than can be carried during the summer on the remaining grassland, which is poor in both quantity and quality. This state of affairs will be rectified as a greater part of each farm is reseeded. In the meantime additional grass keep for the summer is greatly sought after to avoid unnecessary buying and selling, and to ensure having sufficient cattle in the winter to make the maximum amount of farmyard manure and thereby maintain the fertility of the farm.

Extra grass keep during the summer enables the dairy farmer to make a better provision for producing winter milk, either by more ploughing for suitable tillage crops or by putting up a larger acreage for hay. It has also enabled some farmers to avoid selling either young heifers or young cows in the spring. Last year one farmer testified that had the Committee not provided him with grass keep, he would have had to sell 50 attested Friesian heifers which were bulled for autumn calving.

With all agistment, priority is given to dairy cattle. These are divided into three groups—attested stock, T.T. stock, and other dairy stock—and separate grazings provided accordingly. Other classes of cattle, mainly stores, are grouped similarly, since Montgomeryshire has many attested herds which are not producing milk. Sheep are taken for agistment only in the late summer and autumn, according to the quantity of keep available.

AGISTMENT OF CATTLE ON IMPROVED UPLAND GRAZINGS

The Committee is anxious that these grazing areas should not become centres of disease dissemination, and for this reason all female cattle must be submitted to the agglutination test and the results forwarded to the Committee. Areas are then set aside for these cattle, and provision is made elsewhere for those which do not pass the test.

Growing Success of the Scheme When the agistment scheme was first suggested in the early spring of 1943 there was much local comment, especially since dairy cattle were to be given preference. Many "wise-acres" contended that it would be little short of sheer madness for any farmer to send dairy cattle, especially Friesians, to graze at such elevations; they might as well be sent straight to the knacker-yard! However, as always, there were a few who had faith and courage, so that eventually over 500 cattle, mostly bulling and in-calf heifers, were sent for the five months period. From past experience the Committee advised those sending young cattle to inoculate them against pneumonia; although it may not be essential, it is a wise precaution. Visitors in May were amazed to see Shorthorn, Friesian, Ayrshire and cross-bred heifers, all from the lowland farms, grazing at elevations between 1,200 and 1,600 ft. above sea-level: most of the Friesian heifers were still on the hill in November, and casualties were less than 0·5 per cent. The real test was, of course, the opinion of the owner when his stock came down in the autumn. It must, however, have been satisfactory, since the majority have applied to send their cattle again this year. There are also a number of new applicants, and already over 1,600 cattle have been offered to the Committee for agistment.

One outstanding problem is that of marking each farmer's cattle so that they can be identified easily. The Committee has various schemes in prospect, but suggestions would be welcome.

Mutual Benefit to Upland and Lowland Farmers In doing this work the Committee is re-establishing an old custom whereby large numbers of cattle were sent from the lowlands to summer on the hills. The advantages of the system to the lowland farmer have already been indicated. As regards the hill farmer, he is in many cases, even to-day, in a precarious economic position, and one way of improvement is to marry the upland and lowland farm so that the former can share the prosperity of the latter to mutual advantage. Many upland farmers who have reseeded during the past few years are beginning to follow the example of the Committee, which is doing all it can to arrange contracts between individual upland and lowland farmers. Upland farmers who agist cattle on the same terms as the Committee, namely, £3 per head for the five months period, actually receive £6 per head, since if the necessary conditions of the Hill Cattle Subsidy Scheme are fulfilled the occupier of the grazing land receives the subsidy of £3 per head. On this basis reseeded upland areas belonging to the Committee have given a return of over £6 per acre, which is a handsome return from land having an original rental value of 4s. per acre. There must be a place for the upland farmer in British agriculture after the war, and the Committee hopes that the present practice may be carried into the peace to the economic benefit of both upland and lowland farmers.

TAKE-ALL OF CEREALS IN 1943

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Rothamsted Experimental Station

TAKE-ALL disease was more than usually prevalent in autumn-sown wheat crops harvested in 1943. In some fields the disease attracted attention as early as May, when irregular areas of the crop were seen to be backward in growth and obviously unthrifty. In the majority of outbreaks, however, the disease was not noticed until after the crop had headed; the plants affected by Take-all ripened early to give typical "whiteheads," with little or no grain in the ear. By harvest time, such whitehead plants had usually become discoloured by a greyish-black mould growth. This superficial growth of mould is not the cause but merely an effect of the disease; the Take-all fungus itself (*Ophiobolus graminis*) is to be found as black flakes between the leaf-sheaths and the stem at the base of the plant. It may also blacken the roots.

Conditions Favouring Take-all During the past seven years we have surveyed, wheat fields in the counties of Northamptonshire Buckinghamshire, Berkshire, Oxfordshire, Hampshire, Dorset and the Isle of Wight. More fields were affected with Take-all in 1943 than in any other year. In the spring of last year, we had anticipated a fairly widespread occurrence of the disease in autumn-sown wheat crops, for the following reasons. First, the 1942–43 winter was exceptionally mild, and higher average soil temperatures are likely to favour the underground spread of the Take-all fungus along the roots of the winter wheat. Secondly, double the normal amount of rain fell in January; this caused leaching of soluble nitrogen from the soil, and resulted in symptoms of nitrogen starvation appearing in many autumn-sown wheat crops in the spring. Nitrogen starvation is known to lower resistance of wheat to Take-all disease, and the soil remained sufficiently moist up to the end of May to permit continued progress of the fungus on the roots. In June and early July a prolonged hot dry spell occurred, and plants with defective root systems were checked in their growth; many bleached off later in the manner characteristic of plants affected at the crown by Take-all. Conditions in 1943 thus seemed likely to favour a more widespread occurrence of the disease than usual, and this expectation was duly fulfilled, as shown by our survey.

Estimation of Disease The method of sampling crops for disease estimation was as follows. If a crop appeared to have more than 1 per cent. of tillers affected by Take-all, 10 samples were taken at random on a diagonal traverse of the crop. Each sample consisted of a double handful of straws, comprising not less than 20 eared tillers. From the 200 or more eared tillers thus collected, the whitehead tillers were picked out and counted, the presence of the Take-all fungus being confirmed by examining the tiller bases for the characteristic blackening associated with the disease. Tillers which had obviously been prevented by the disease from producing an ear (e.g., single-tiller plants) were included in the count of whitehead tillers.

Effect of Rotation The occurrence of Take-all, as was to be expected, was most frequent and most severe in wheat following wheat or barley. The effect of a second consecutive susceptible crop in increasing the incidence of the disease was well illustrated on certain fields, on the two halves of which slightly different rotations had been followed. For example, in a field of wheat at Castle Ashby, Northants, many white-heads were found at harvest time on one half but not on the other. The history of the field was as follows:

1939	Old grass	
1940	Wheat, partially failed and patched with barley	
1941	Wheat	
1942	Barley	Potatoes
1943	Wheat—38 *per cent. tillers with Take-all*	Wheat—*No tillers with Take-all*

The substitution of potatoes for barley in 1942 on one half of the field had evidently starved-out the Take-all fungus left on the roots of the 1941 wheat crop, whereas the fungus was perpetuated on the half that was sown to barley in 1942, and caused serious trouble on that half of the field in 1943.

Another instance of a striking increase of Take-all in a second wheat crop after old grass was seen at Little Atherfield, Isle of Wight, on a field divided into two parts:

1941	Old grass	
1942	Wheat	Old grass
1943	Wheat—45 *per cent. tillers with Take-all*	Wheat—*No tillers with Take-all*

There was serious infection in that half of the field in a second wheat crop in 1943, but no obvious disease in the first crop following grass. Neverthe-less, when examined under the dissecting microscope, infection was detected on the root systems of 14 out of 32 "healthy" plants from this part of the field. Samples taken from another second wheat crop after old grass ploughed up and summer fallowed at Ovington, Hants, gave 33 per cent. tillers with Take-all. On the other hand, in a second wheat crop after old grass on Martin Down, Hants, where the disease was present only in small, chalky patches, it was estimated from inspection of the standing crop that no more than 1–3 per cent. of whitehead tillers was present.

Beneficial Effect of Ryegrass-and-Clover Ley The effect of a ryegrass-and-clover ley upon the survival of the Take-all fungus between susceptible cereal crops is of practical interest. From our field surveys we have concluded that the Take-all fungus declines under a ryegrass-and-clover ley to a relatively low level, in contrast with its behaviour under a wheat or barley crop, or under certain susceptible weed grasses. Occasionally, however, wheat may suffer appreciable loss from Take-all after a ryegrass-and-clover ley, as on a field sampled at Courteenhall, Northants:

1939	Old grass
1940	Oats
1941	Wheat
1942	Ryegrass and clover
1943	Wheat—17 *per cent. tillers with Take-all*

Such a high incidence of Take-all after a ryegrass-and-clover ley is excep-tional, and may possibly have been due to the presence in the ley of susceptible weed grasses.

Weed Grasses as Carriers of Take-all In contrast with the behaviour of the ryegrasses, certain weed grasses with creeping underground stems (rhizomes) have been found to be as bad as a wheat or barley crop in permitting multiplication of the Take-all fungus in the soil. We have traced severe outbreaks of Take-all in wheat to each of the following perennial grasses: couch grass (*Agropyron repens*), Yorkshire fog (*Holcus lanatus*), and bent grass (*Agrostis* sp.). The effective perpetuation of the fungus on the underground parts of such grasses is probably due not so much to their specific susceptibility to infection as to their perennial habit and vigorous growth. Even on the most susceptible annual grasses, such as slender foxtail or black grass (*Alopecurus agrestis*), the life of the Take-all fungus is curtailed by the death of its host plant at or before the end of the growing season.

Infestation of land by these perennial weed grasses is often the cause of unexpected outbreaks of Take-all in crops grown under otherwise excellent rotations, as witness the following two examples from our 1943 survey. The first case was encountered near Newport, Isle of Wight, on a field that had been divided into two parts:

1920–40	Vegetables for at least 20 years	
1941	Potatoes	Vegetables
1942	Wheat	Potatoes
1943	Wheat—66 *per cent. tillers with Take-all*	Wheat—13 *per cent. tillers with Take-all*

From the above sequence of cropping with such a long period without a cereal crop or grass, it would seem impossible to explain this outbreak of Take-all. Inspection of the field, however, at once revealed a heavy infestation of bent grass (*Agrostis* sp.), the underground parts of which were, in many instances, infected by the Take-all fungus.

A similar case was encountered at Beauworth, Hants, where the field had again been divided into two parts:

1939	Old grass	
1940	Oats (spring-sown)	Old grass
1941	Oats (winter-sown)	Old grass
1942	Potatoes	Potatoes
1943	Wheat—31 *per cent. tillers with Take-all*	Wheat—1 *per cent. tillers with Take-all*

The occurrence of 31 per cent. tillers with Take-all in wheat after two crops of oats and one of potatoes was hard to explain in view of the fact that oats are highly resistant to infection by *Ophiobolus graminis*. It seemed possible that the outbreak was due not to the usual strain of the Take-all fungus affecting wheat but to the special variety (*O. graminis*, var. *Avenae*) which attacks oats. So far this has been reported only from Shropshire, Cumberland, Wales and Scotland. Further investigations showed, however, that the fungus was definitely the wheat strain, and that it could not attack oat seedlings. After this finding and a further checking of the crop sequence from the farm records, another visit was made to the field after harvest. An explanation was then suggested by a strong development of infected couch grass amongst the stubble, chiefly on that part of the field ploughed early in 1940. It thus appears that from original foci of infection under old grass, the Take-all fungus may multiply extensively not only on the roots of a wheat or barley crop, but also on the underground parts of a susceptible perennial grass weed.

The observations recorded above confirm the soundness of the accepted recommendations for the control of Take-all—namely, that the best insurance against the disease is clean land and a good rotation of crops.

BLIGHT

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A century ago, towards the end of July, 1845, the potato crops of the British Isles and the Continent were affected by a plague that destroyed the fresh green haulm and converted it into a blackened waste and rottenness. Relentlessly the plague struck, but it was in Ireland that the full weight of the attack was felt. In the tragic years 1845–47 men, women and children died of starvation in their tens of thousands.

At the time the more observant had noticed a mould on the decaying haulm, but it was assumed that this was the consequence of the decay and not the cause of it. The Rev. M. J. Berkeley, a celebrated Cambridge botanist who investigated the nature of this potato plague, thought, however, that the decay was the consequence of the mould and, by his detailed observations, did much to prove it.

A century ago may seem remote, but the present is a good time to remember that microscopic enemies still constitute a serious threat, and that Blight (as this disease is now known), in particular, is one of them. This malignant mould, *Phytophthora infestans,* has beset the potato crop for 100 years, and unless the grower continues to pit his skill and ingenuity against it, it may well survive another hundred years. It is unfortunate, and especially so in these momentous years, that many farmers are unfamiliar with the strategy of Potato Blight control, and are content to accept its ravages as an unavoidable evil. Losses from Blight can be reduced by very simple measures within the scope of every farmer.

How Does the Disease Start ? Before particularizing the methods of control, it is necessary to know something of the life history of the fungus causing the disease. The way of it is this. Blight usually begins on shoots produced by *blighted* tubers thrown away when the clamp is opened or left in the field the previous autumn. It may also start on shoots produced from blighted tubers planted among healthy ones. These blighted shoots are the concentration points from which the attack develops. Given a warm and moist summer—factors upon which the Blight fungus is dependent—the attack will be pushed home and an epidemic result. Is it not clear, therefore, that the potato-grower must do all he can to prevent or destroy these centres of infection ?

How should he set about this ? In the first place, and as far as is practicably possible, he should avoid leaving tubers on the field to form "volunteer" plants. As neither the plough nor the spinner will deal *completely* with the harvesting of the crop, he should run the harrows over the picked portion of the field at the end of each day, and collect the exposed tubers. The field should then be dragged with the cultivator, and any more tubers brought up should be collected and clamped separately with the harrowings. It should be remembered that not only do "volunteer" plants harbour Blight and eelworm, but they help to spread the virus diseases as well.

Where there is Rubbish there is usually Disease Time and time again the first outbreaks of Blight have been found near the site of old potato clamps. That this is the paramount danger is not generally realized. When the clamp is opened diseased tubers should not be tossed out and left lying about to harbour disease. They should be collected, sorted over and, wherever possible, the best of them boiled and used for pig feeding: the remainder should be burnt (not an

easy matter) or else thrown into a pit, trampled down, and covered with a deep layer of soil. Too often rubbish of this sort is dumped on some convenient site, very often close to a potato field, and left to produce diseased "volunteer" plants.

As soon as possible the clamp site should be ploughed and a catch crop taken. It is an axiom of sound farming practice to start with clean stocks, and the potato is no exception. *Plant clean seed which is virus-free, or relatively so, and discard all tubers showing Blight or Dry Rot.* Wherever possible, seed should be boxed and periodically examined, for blighted tubers sprout prematurely and thus, with experience, can be detected and discarded during the winter.

Where is Blight likely to Appear First ? Fungi, as well as farmers, have their likes and dislikes ! Blight usually appears first on low-lying parts of fields or in sheltered situations where the air is moist and stagnant. It is not always possible to avoid such situations, but if the crop must be grown under such conditions, then the very susceptible varieties, such as King Edward, Up-to-Date, and British Queen, should not be planted.

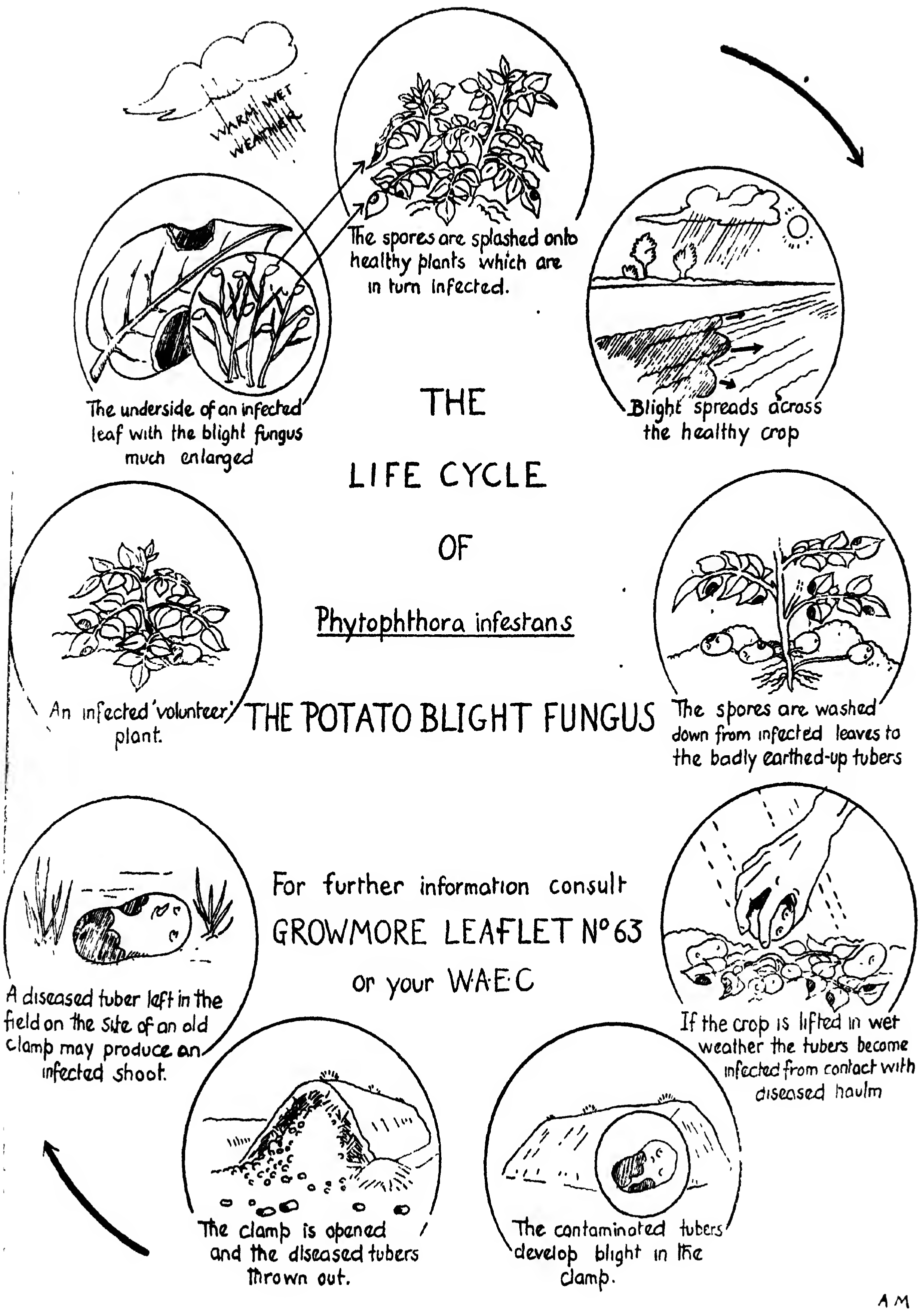
Not only the tuber but the haulm also is susceptible to attack ; consequently, if high yields are to be obtained and loss in the clamp prevented, both the haulm and the tuber must be protected from attack. Before describing the methods by which we must combat the fungus, we must consider in a general way the tactics which the organism will employ in invading the crop. Essentially these are not unlike those employed in modern warfare, for Blight adopts both aerial and subterranean methods. If every potato-grower would realize this, losses would be much reduced in the annual battle in the war against this disease.

Method of Attack The Blight fungus, having established its assault quarters—for example, the site of an old potato clamp—waits with consummate generalship for the right weather and then, when warm, moist periods occur, multiplies its reserves by breeding fresh disease germs on the shoots and leaves of affected plants and with these strikes at the nearest potato crop. Here it consolidates its position and builds up fresh reserves to drive home the attack in the splashes of falling rain drops and wind-driven rain. If dry weather intervenes the attack is halted and the invasion postponed until later in the season when moist and warm periods are more likely to occur. This phase is somewhat similar to an assault made by air-borne troops, the spores of the disease in this case being airborne in minute drops of water.

There is, however, a second but equally important objective—the tuber ; for if the disease is to achieve its purpose, this too must be attacked.

How is this underground objective achieved ? The spores formed on the leaves and shoots are washed down to the soil during rainstorms and are carried for short distances through cracks in the soil. If there they come into contact with a tuber they infect it and produce the well-known brown or "fox-red" markings just below the skin. The spores, however, are very delicate and have but a short life in which to achieve their purpose.

Good Earthing Up will Protect the Tubers The better the earthing up the smaller the chance Blight spores will have of reaching the tubers through the soil. Plenty of soil and compactness at the sides and tops of the drills should be the aim. The ideal is a bulky, crested ridge ; the thing to avoid, a shallow split-topped


WARM WET WEATHER
The spores are splashed onto healthy plants which are in turn infected.
Blight spreads across the healthy crop
The underside of an infected leaf with the blight fungus much enlarged
THE
LIFE CYCLE
OF
Phytophthora infestans
THE POTATO BLIGHT FUNGUS
An infected 'volunteer' plant.
The spores are washed down from infected leaves to the badly earthed-up tubers
For further information consult
GROWMORE LEAFLET N° 63
or your W·A·E·C
A diseased tuber left in the field on the site of an old clamp may produce an infected shoot.
If the crop is lifted in wet weather the tubers become infected from contact with diseased haulm
The clamp is opened and the diseased tubers thrown out.
The contaminated tubers develop blight in the clamp.
A M

covering. It should be stressed here that *a good ridge that reduces the chances of greening to the minimum will likewise reduce Blight.* All too often—especially with inexperienced potato-growers—weak ridges are seen, with the tubers growing on the surface or appearing through the sides. In a Blight year it is inevitable that these tubers will become blighted. If potato-growers would realize that Blight does not work down through the haulm to the tuber, but that infection occurs from spores that have been washed down from the leaves then, in a Blight year, many tens of thousands of tons of produce would be saved.

Blight in the Clamp From what has been said so far it will be noted that the suggested precautions for avoiding losses from Blight have not involved any substantial increase of capital expenditure. "But why is it," a grower may ask, "that my clamp is rotten with Blight, although I moulded up the tubers well ? " The reason is that good earthing up prevents Blight only while the tubers are in the soil. As soon as they are exposed to the air at lifting time, they are vulnerable to attack. If some of the haulm is still green with Blight spots on the leaves, the spores may come into contact with the tubers and infect them. This will certainly happen if the tubers are lifted and clamped under wet conditions. Some farmers believe that Blight spreads from tuber to tuber in the clamp, but this is a fallacy. Certain kinds of wet rot may spread in the clamp, but Blight does not spread appreciably by contact in this way. This was well illustrated in a commercial clamp on the Cambridge University Farm from which sections were "dressed" at intervals from December, 1942, to August, 1943. Throughout this period wastage due to Blight among ware tubers remained relatively constant at about 3 per cent. What actually happens is this: if the appropriate precautions have not been taken Blight spores come into contact with the healthy tubers and, if these are wet, infect them. Although they appear to be sound when clamped, they are already contaminated by invisible spores which germinate and infect the flesh. It should be noted, therefore, that in certain circumstances the tuber is contaminated or infected before it enters the clamp, and that during storage the disease progresses in the individual tuber.

Whenever possible, therefore, lifting, carting and clamping should be done in dry weather, for Blight infects tubers only when they are wet. If lifting can be delayed until the tops have been quite dead for at least a fortnight, the risk of the tubers becoming infected during harvesting is negligible, and no special precautions need be taken. If, however, the tops remain green very late, with Blight spots on them, they should be destroyed ten days or more before the tubers are lifted.

On small areas of an acre or so scything or mowing is practicable, but on large acreages chemical means are employed, usually by spraying with a solution of sulphuric acid. Burning off with sulphuric acid is practised mainly in the northern half of the country, and the work is usually carried out by contractors, because of the special acid-resisting machines required.

Protecting the Haulm As most growers know, the haulm can be protected by spraying the crop with Bordeaux or Burgundy mixtures, or by dusting with copper powders prepared for this purpose. Full details as to their preparation and application are given in "Growmore" Leaflet No. 63,* and information on the matter can also be obtained from the War Agricultural Executive Committees. It is

* *Potato Blight on Farms*, obtainable free and post free from the Ministry, Berri Court Hotel, St. Annes-on-Sea, Lancs.

always wise to seek local advice, because the incidence of Blight is not the same in all parts of the country. Blight appears first, and is most severe, in southern and coastal districts, and here spraying or dusting the haulm with copper compounds should be regarded as a routine summer operation. In midland and northern districts it appears later and is often less severe, so that in these parts it is generally sufficient to protect the tubers by proper earthing up and by destroying diseased haulm before lifting. It is advisable, however, in all districts to spray or dust King Edward, British Queen and Up-to-Date, as these are very susceptible varieties.

Warning.—In the neighbourhood of industrial areas spraying and dusting may do more harm than good, owing to the action that takes place between the spray and acid fumes in the atmosphere. This is one of the reasons why local advice should be sought before spraying or dusting potatoes within ten or twelve miles of a large industrial centre.

Blight in War Time A century of warfare against Potato Blight has passed, but still this fungus is a virulent menace. On the whole the years have been kind to us. In the wet summer of 1939 Blight came early to the eastern counties, but did not develop severely there or elsewhere in the country until the end of July and the beginning of August. This unpromising start, however, was compensated largely by the exceptionally warm and sunny early autumn, resulting in less tuber wastage than was expected.

In the dry season of 1940, the disease was of little consequence and, although it appeared in the West in the first week of June and in Lincolnshire in July, it made little progress except in certain coastal areas. In East Anglia wastage in clamped tubers consisted primarily of Dry Rot and, in an extensive survey, Blight was found in clamps only in coastal districts in Lincolnshire.

The year 1941, however, was characterized by a late, widespread attack of sustained severity, which followed the more or less simultaneous occurrence of the disease in July in coastal areas of Lincolnshire, Wales and the south-west of England. Crops in midland and north-west districts, on the other hand, were not generally affected until September. In this year the wastage in tubers was heavy, especially around the Wash and in northern districts, where a 50 per cent. loss was commonly reported. Wastage in East Anglia varied from 5–60 per cent., with an average estimated at 8–10 per cent. The mean percentage wastage in different varieties showed little variation, although individual cases of wastage with the variety King Edward VII were far in excess of any other variety. Dry Rot was rare in the clamps examined—a striking contrast with conditions prevailing during the previous year. Little or no wastage due to Blight occurred in clamps in the South-west.

Although Blight was recorded from Wales in 1942 as early as the second week of June, the first main records were not reported until mid-July, and then from various localities in coastal districts in the South-west, Hampshire, Lincolnshire and Norfolk. Progress was rapid, and by the end of August Blight was generally distributed throughout the southern part of the country. Although moderate in intensity, Blight attack in East Anglia was associated with widespread and heavy aphis infestation, and before mid-September fenland crops were mostly defoliated. Wastage of tubers due to Blight attack was markedly less than in the previous year and, in a survey of clamps throughout the eastern counties, it amounted to an average of just over 3 per cent. The premature death of the haulm

in 1942 was undoubtedly responsible for the reduced amount of tuber infection at lifting time, particularly on those farms where otherwise the crop would have been lifted with the haulm partly green.

During 1943, the fifth of these critical years, Blight was first noticed in Cornwall at the end of May, and by the third week of June in other localities in the South-west, Wales, southern coastal area and in the neighbourhood of the Wash. After this early start the disease was kept in check in the eastern part of the country by the dry conditions which persisted throughout July and August, and little development took place until mid-September. By this time, in East Anglia, the potato tops were mostly dead, following premature ripening associated with past drought conditions, and tuber wastage was relatively slight. Elsewhere in the country the disease was not checked to the same extent, and in many areas adverse weather conditions were followed by considerable progress of the disease, and instances of heavy tuber wastage have been reported from some districts.

But what will be written of the 1944 season? It is largely up to you!

BLACKPOOL SCHOOL CHILDREN AND THE POTATO HARVEST

J. J. Breeze, M.A.

The Grammar School, Blackpool

THE call of the land came to the schools of Blackpool last year when Mr. Porteous, the Labour Officer of the Lancashire War Agricultural Executive Committee, stressed the importance of getting the children to help gather the potato harvest. A scheme was accordingly prepared and duly approved by the Blackpool Education Committee in May to come into operation as soon as required. Actually the children started their land work on October 4 and finished on November 12.

Little Interference with School Life

The scheme provided that farmers requiring assistance should apply to the Labour Officer at Hutton. This officer passed on the information to the "Controller" of the scheme, who in turn called on the various schools to supply the labour required. By this method the work was spread evenly among the schools volunteering to assist and the normal school life of the children suffered the minimum of interference. The schools taking part in the scheme remained in session the whole time.

All the Secondary Schools, the Technical College and the Senior Elementary Schools participated in the scheme, and the number of volunteers was as follows:

Elementary Schools (12)	952
Secondary Schools (7)	1,253
Technical College (1)	56
Total	2,261

More Than 2,000 tons Picked

All parties of children sent out were organized, and in every case they spent the whole day on the farms. The average number of hours worked daily by the children was slightly under five, and as it was exceptional for any child to go out two days in succession, no complaints of children

suffering from fatigue were received. During the six weeks the scheme was functioning, 62 farms were serviced, the total number of hours worked was 34,097, and more than 2,000 tons of potatoes were picked. At the peak of the season an average of 293 children were being sent out daily.

Transport and Supervision The children were transported to and from the farms in Blackpool Corporation buses, hired by the Lancashire War Agricultural Executive Committee. The buses remained at the last farm serviced for the day, and began the return journey about 4 p.m.

It was not possible to supervise the children on every farm, for shortage of staff and the fact that any one school might be servicing six or more farms in a day made this impracticable. But all schools sent teachers to supervise the children in the buses, and these usually remained at the last farm serviced for the day. In cases where 15 or more children were required by a farmer, it was possible for the school concerned to send a teacher to that farm. In other cases a leader was appointed from among the party, and he or she handed the wage sheet to the farmer in the morning and collected the wages at night. The money was then passed over to the Head of the school from which the party came and, after the insurance money had been deducted, disbursed among the children.

Wages and Insurance All pickers were paid at the rate of 8d. an hour, and the hours worked were reckoned from arrival on the farm until departure, excluding one hour's break for lunch. Some farmers were so pleased that they paid the children bonuses.

A Personal Accident Policy was taken out to cover all the children concerned. The Corporation of Blackpool paid the premium in the first instance, but this premium, which was deducted from all pickers at the rate of 2s. 6d. per 100 hours, was repaid to the Corporation at the conclusion of the work. An adjustment was necessary to cover the extra hours worked.

Increased Appetites The provision of adequate food for the children is of supreme importance. All children took a packed lunch with them, and the farmers supplied each child with a hot drink during the dinner hour. In many instances farmers provided the children with additional food. But the ordinary rations were found to be insufficient, since the healthy work increased the children's appetites considerably. Of course, farmers can procure additional rations for the potato harvest, but the fact that they have different children each day makes the distribution of such rations very difficult. It would perhaps be much better if travelling canteens could be made available, each one to serve a certain number of farms in an area. Even hot pies would be very acceptable.

Importance of an Efficient "Controller" The scheme was an outstanding success, due principally to the loyalty and co-operation of the Heads and assistants of all schools and the behaviour and industry of the children. It must be stressed, however, that the position of the "Controller" is all-important. He or she is the linch pin of the whole scheme, and its success or failure depends entirely upon his or her labours. It is therefore necessary to choose someone who has the full confidence of the Heads of all schools and one who, in general, is keenly interested in agriculture. It is a full-time job, for in addition to organizing the parties, he or she has to deal with com-

plaints that may arise from both the schools and the farmers, answer the many questions which pour in during the day, and collect the insurance money. It is certainly a one-man job, for quick decisions have to be made. Whether or not the position should be given to any person other than a member of the teaching profession is a matter of opinion but, generally speaking, the Heads of schools prefer to deal with one of their own profession.

"A Grand Scheme" As a whole, the farmers were greatly pleased with the work done by the children. "A grand scheme in these days of war, and a fine lot of boys and girls," said one of them. For the children's part, they thoroughly enjoyed the work, for not only did they get an insight into farm work generally, but they felt they were taking a real and active part in work of national importance at a critical time.

FRONT-LINE FARMING

KENT'S WAR-TIME EFFORT

P. W. Cox, O.B.E.

Kent War Agricultural Executive Committee

TO many, Kent is known as the "Garden of England". Although, as a Man of Kent, the writer has no desire to belittle this time-honoured reputation, it is nevertheless somewhat misleading. The implication which the phrase conveys can apply correctly only to a comparatively small part of the county. Against this must be set the large areas of poor lands, the dull reddish wet clay-with-flints soils—sticky in winter and hard and intractable in summer—the shallow chalk soils, the stiff tenacious gault clay strip at the foot of the chalk escarpment of the North Downs, and, covering an area larger than any of these, there is the Wealden Plain, an area described by Hall and Russell as "of true clay, the wetness and heaviness of which is aggravated by its general flatness and low elevation, causing the natural drainage of the country to be poor".

Legacy of Neglect in 1939 At the outbreak of war, following a score or more years of acute agricultural depression, bright spots could still be found in all the rural districts of the county, but the effect of the depression was indeed widely visible from the lanes and by-ways running through all these areas. Many fields had tumbled down to useless grass, pastures were practically waterlogged, owing to years of neglect of the field ditches and watercourses, and hedges were overgrown. Compared with the scene to-day, the countryside had a very unkempt and uncared for appearance. To bring production up to the level which, by dint of sustained hard work on the part of the farmer and farm worker has been achieved, the farming community was confronted with a Herculean task.

On the other hand, the county can justly claim some of the most productive soils of Britain; the brick earths carrying the finest cherry orchards in the world, fruit plantations, hop gardens and fields of vegetables second to none—in fact, a worthy Garden of England. There are also the variable but generally free-working Hythe Beds of the lower greensand soils, useful for all kinds of farming, and the rich alluvial areas, including

Romney Marsh, where can be found some of the most productive land under the plough and fine rich pastures, some of which are capable of fattening as many as eight sheep to the acre without the aid of other food.

With such a great diversity of soils, many types of farming are being followed—more perhaps than in any other county. Fruit, hops, corn, vegetables, sugar beet, and flax—all are grown ; while dairying and the rearing of cattle and sheep are practised extensively.

Pre-War Preparations When war came the farmers were not quite in the dark as to the magnitude of their task. Fortunately, in the previous May, the Chairman-designate to the War Agricultural Executive Committee (Capt. The Lord Cornwallis, M.C.) had addressed a letter to every farmer in the county occupying holdings of 50 acres or over, in which he conveyed to them in general terms the policy which would be followed should war unhappily occur, adding that in spite of the adversities they had experienced and were continuing to face, he knew "the country could rely upon the farmers of Kent loyally to respond to any appeals which the Minister of Agriculture, on behalf of the Government, might have cause to make upon them". He also invited them to let him know the acreage of permanent grassland which was then being ploughed in accordance with the Government Scheme announced in the House of Commons on May 3, 1939, and the additional acreage which they could and would proceed to plough should war be declared. The response to this letter was encouraging, for less than a score failed to reply. The returns they made showed that 6,761 acres of permanent grassland were in process of being ploughed up under the £2 an acre Subsidy Scheme, and a further 18,039 acres were "volunteered" should war break out.

Another interesting feature disclosed was the labour available on the farms for tackling this task. Fifteen per cent. of the male workers were under 21 years of age, 9 per cent. were between 21 and 25 years of age ; 76 per cent. were over 25 years of age, and no less than 7 per cent. (including the farmers' sons) were either members of the Territorial Army or Reservists who would be called for service immediately war was declared—a loss which would be felt profoundly, bearing in mind that this 7 per cent. embraced the cream of those who had stuck doggedly to farming and were, in consequence, the more skilled and vigorous men on the farms.

At the same time steps were being taken to frame the war-time organization, including the provisional appointment of Parish Representatives, or "Farmer Surveyors" as they were eventually designated. These men have throughout the war continuously rendered invaluable service without thought of remuneration or reward of any kind, and have conscientiously endeavoured to be "guide, philosopher and friend" to all members of the farming community in their respective parishes. The care with which they have fulfilled their responsible and at times unenviable tasks may be gauged by the fact that the number of appeals against ploughing directions served by the Executive Committee, as a result of the recommendations the Farmer Surveyors have submitted, has been almost negligible—in fact, it does not exceed 5 per cent. of the 17,060 directions (the majority of a formal nature) which have been issued by the Committee since the outbreak of war.

The Labour Problem The main problem throughout has undoubtedly been the provision of sufficient labour. From the outset, Kent farmers have been ready to accept the services of the Women's Land Army ; to-day there are 3,968 employed in the county,

and there is an unsatisfied demand which cannot be overcome so long as recruiting has to be restricted. In addition, the Committee has taken into its employment from Labour Exchanges every man who could possibly be regarded as suitable for employment in gangs on contract work. The Committee employs 20 gangs comprising 347 men, excluding prisoners of war who number some 600. The provision of accommodation for this supplementary labour has always been an acute problem. Thirty-four hostels have been opened and others will continue to be established as suitable premises become available.

Training courses of 4 and 6 weeks duration for Land Army milkers and forewomen are being held continuously at two centres in the county, and a course for tractor drivers is being run at another centre. A considerable number of workers have also been trained as threshing machine drivers, and eight land girls, working in couples, have been successfully operating Cub Excavators for the past two years clearing ditches. Their work output compares very favourably with that of the other drivers.

The Mechanized Arm Before the war there were only one or two contractors for cultivation work, and most of the 36 steam ploughing sets which were working in the county at the end of the 1914-18 war had long ceased to be used. Few, if any, farms were adequately equipped to deal with a sudden expansion in the tillage acreage; in fact, there was at that time only about one-third of the farm tractors which are in use in the county to-day.

In these circumstances the Committee lost no time in setting up and equipping a number of "selected contractors" in various districts. To-day, there are 196 registered agricultural contractors undertaking ploughing and cultivation work, 68 of whom are "selected contractors" hiring tractors and implements from the Committee and undertaking contract work for farmers at acreage rates fixed within a price range approved by the Committee. In addition, the Committee has 58 hiring depots from which farmers can hire implements on a daily basis. During one quarter of 1943, 2,085 hirings were recorded—an increase of 28 per cent. over the corresponding period for the previous year.

The Committee has available for hiring, either to contractors or to farmers direct, some 238 tractors, 1,732 implements and other machines, 344 binders and 50 threshing machines. It has also a considerable number of tractors and implements allocated to its farms which are mentioned later in this article. The "Help Your Neighbour" policy has always been encouraged, and indeed, has been widely observed throughout the county.

Threshing During the last war the threshing industry throughout the county was organized by allocating "runs" for the machines, with five helpers detailed to assist with each. With the present increased corn acreage, some organization had again to be devised. In collaboration with the threshing machine proprietors, the Committee therefore introduced a scheme on somewhat similar lines for dealing with the 1941-42 crops, except that the number of land girls was limited to 4 per set. The county was "zoned," and approximately 1,000 acres of threshing were allocated to each machine—except on Romney Marsh, where the heavier crops made it desirable to limit the acreage to approximately 800 per machine. This scheme has been worked most successfully each season, the number of land girls employed on threshing being nearly 400.

The total number of "proprietor"-owned threshing sets working in the county during the current season is 152, and there are 147 farmers who have machinery of their own. Four sets are directly operated by

Ploughing to the very edge of the cliffs of Dover—a lonely job within range of the Nazi guns across the Straits.

Devon cattle are still kept at Reach Court Farm despite enemy shelling

Top: Salvaging potatoes at East Langton.

Bottom: Romney Marsh ewes heavy in lamb, run at the rate of four to the acre in winter.

The Garden of England. (*Keystone* photograph,

the Committee; one (an American peg-drum set) driven by trainees has done exceptionally good work, having completed this season (up to the end of March) just on 1,400 threshing hours; this figure would have been higher but for the fact that it has been necessary to send this particular set on emergency threshing work to various parts of the county, which has consequently increased the travelling time. On one occasion this set threshed out 95 quarters of wheat in one day.

Another of the Committee's sets (an English machine) is operated entirely by land girls, who were trained to the work three years ago. Led by 26-years-old Mrs. Olive Bass, who was a dressmaker before the war, the team has operated the set on every farm in the area allotted to it during the past two threshing seasons. The work has necessitated 48 journeys to farms, and the sight of Mrs. Bass skilfully steering the high-powered tractor, with its threshing machine, caravan, elevator and trusser, along the country lanes and high roads—up and down hills—and to see her manoeuvre the outfit into the most difficult stackyard, setting it up to the stacks and adjusting it to a dead horizontal position—excites the admiration of both farmer and general public.

Up to the end of March this set had a record of 1,400 threshing hours; and according to the threshing returns made by the farmers to the Committee under the Threshing of Grain Order, it has threshed the following amount of corn:

	cwt.		*cwt.*
Wheat	13,302	Dredge Corn	1,006
Barley	179	Oats	3,852
Rye	39	Beans and Peas ..	1,192
		Other Crops	32

Land Drainage The Committee has a heavy programme of drainage works in hand, as the following figures up to December 31, 1943, indicate:

SCHEMES APPROVED

	Number	Area of Benefit	Estimated Cost
		acres	£
Tile	434	2,720	31,167
Mole	278	7,080	14,933
Ditches	2,096	84,523	162,832

SCHEMES COMPLETED

	Number	Area of Benefit	Cost of Work
		acres	£
Tile	223	1,068	12,388
Mole	86	1,564	3,574
Ditches	1,034	29,180	58,455

The Committee is operating 20 excavators which, by shift changing of drivers, are kept running practically all the hours of daylight—stopping only every alternate week-end. The drivers are paid an output bonus, calculated in accordance with a formula agreed by the men and approved by the Ministry.

Mention has been made of the Wealden Plain. The main drainage artery of this large tract of the county is the River Beult, which has its source at Bethersden. Flowing westwards, it joins the Medway at Yalding. This important agricultural waterway had been neglected for a century or more until the Kent Rivers Catchment Board was constituted under the terms of the Land Drainage Act, 1930. It was fortunate that just prior to the war the Board had prepared a scheme for the dredging and

improvement of this river and, at the request of the War Agricultural Executive Committee, the Board immediately proceeded with its execution and completed the work early in 1942. This greatly improved the drainage conditions in the Weald and enabled the Committee to undertake many farm ditching schemes, so that a considerable acreage of pasture land could be ploughed and brought into cultivation for bread grain crops.

Surveys Each year the Farmer Surveyors have conducted a survey of the farms in their respective parishes. The first survey was purely for the purpose of securing areas of grassland to plough up for wheat and other food crops. The second survey, however, was far more critical and detailed; each farmer had then to be placed in a category according to his efficiency and standard of production.

The third survey directed attention to the establishment of a balanced cropping policy, with a proper proportion of temporary grass for maintaining fertility, whilst more recently a fourth survey has drawn attention to the management of leys and the scheduling of further worn-out pastures to be broken up either for cropping or direct reseeding.

In addition, fruit surveys and livestock surveys have been undertaken by competent farmers. The livestock survey is in progress at the present time and the Committee is focusing attention upon the building up and the improvement of the live stock.

There can be no doubt that the standard of production per acre has been stepped up considerably throughout the county as the result of these surveys. Almost phenomenal yields have been recorded on some farms, as a result of thorough and timely cultivations, seeding and adequate manuring.

The Committee's Farming It was to be expected that several farmers would be beaten by the neglect of the agricultural industry over the last 20 years or more. Altogether 21,744 acres have been taken over by the Committee, although of this acreage a large proportion consisted of derelict land which had been acquired for building development, and considerable acreages of marshland which the graziers willingly handed over to the Committee for the purpose of bringing into arable cultivation. Of the area of 21,744 acres, 9,866 acres have been let by the Committee to approved tenants, and 1,503 acres de-requisitioned to owners who have made satisfactory arrangements for future cultivation.

The acreage which the Committee is called upon to farm varies from time to time according to lettings which are constantly being effected as opportunities occur. At the present moment it is farming 11,500 acres, including 1,206 acres on behalf of the War Department. The latter is on the Cliffs of Dover, within sight of enemy-occupied France and the range of German coastal guns. True, some of the farm dwellings have had to be abandoned and the farm buildings have suffered from blast; true, there is little cover from shell-fire in these open fields flanking Dover Castle, which continues, as of old, to stand sentinel for the liberty of Britain and to frown defiance on our enemy; but still the farm worker daily toils on, undaunted, and as a result the land, right up to the edge of the white chalk cliffs, continues to yield good crops of food for the people of Britain.

A True "Garden of England" It has been impossible in such a short article to refer to many of the Committee's activities, which are so diversified in character—some indeed unique, such as the evacuation from Romney Marsh by train and lorry of thousands of ewes with their lambs in the spring of 1940. Some mention

ought to be made of pest control; the fruit spraying campaign; the land clearing works—especially the grubbing of worn-out fruit lands to make way for other essential crops; the wonderful part that has been played by nurserymen and the growers of glasshouse crops in switching over from flowers to food crops—notably tomatoes; the loyal and devoted service rendered by the Committee's staff in the various departments charged with dealing with the all-important subjects of finance, machinery supplies, labour (supply and reservation), livestock improvement and the maintenance of milk supplies; land drainage; the rationing of feedingstuffs and fertilizers; and so on. These, however, must form the framework of another story after victory has been won; but whoever shall be the writer, he will find it difficult to pen words which will adequately record the unceasing effort of the farmers and their workers so that posterity may realize how great is the debt of gratitude which the nation owes to all who have been associated with the great industry of agriculture in war time.

I cannot do better than conclude by quoting from an article recently written by Lord Cornwallis, the Chairman of the Kent Committee:

> "In the last twenty-five years we have seen many changes in the landscape of England—not always for the better. But in the last four years we have seen a change in landscape back to what it always ought to be. Go where you will in this county of Kent—to the top of the Downs looking down over the Medway Valley and along the ridge overlooking the Weald. Anyone who knew his Kent five years ago will now see a very different picture. Once more does the land begin to look as if it was cared for and once more really worthy of being regarded as 'The Garden of England".

ESSENTIAL FOOD CROPS UNDER GLASS

BERNARD ROCHFORD

Sunningdale, Berks

WHEN the war broke out there was apprehension in some quarters that recognition of the value of protective foods and vitamins might be subordinated to quantity in a war-time food policy. But this fear proved groundless: the Ministries of Food and Agriculture were very much alive to the need for an ample supply of vegetables as a vital necessity for the health of the nation. To counter the rapidly diminishing supplies of all imported fruits, and the ill-effects to health which might consequently ensue, it was decided that every effort should be made to increase supplies of home-grown tomatoes. Lord Horder once told the writer that weight for weight the tomato was richer in vitamins than the orange. (It seems that the orange contains more water, and one does not, of course, eat its thick skin.) However that may be, the decision was fortunate for the glasshouse industry, because it not merely justified the maintenance of glasshouse culture in war time, but gave to the grower an opportunity of making a contribution to the war effort that the public has valued more and more as the war has progressed, and as the absence of citrus and other fruits has been more keenly felt.

Tomatoes and Salad Crops instead of Flowers, Cucumbers and Mushrooms

The change-over from flowers and non-essential food crops to tomatoes and other approved crops was effected compulsorily, but gradually, by Cropping Orders. It stands to the credit of many growers, however, that they made the change more quickly than was required of them by law. The main object of these Cropping Orders has been to provide the public with as many tomatoes as possible from May to October and salad crops in the winter. At first, growers were reluctant to give up cucumbers because it was thought that tomatoes could not be grown satisfactorily in cucumber houses, and also because cucumbers were customarily in great demand by miners and factory workers. But the Ministry of Agriculture decided that cucumbers should not be encouraged since they had little or no food value. Mushrooms were another crop that many growers considered should be permitted on account of their value in making other foods more palatable, but these have even less food value than cucumbers, and their culture under glass has been prohibited entirely. In fact, the Government soon made it quite clear that their prime requirement from the glasshouse industry was the greatest possible quantity of tomatoes; labour, fuel and fertilizers could not be justified for non-essential crops. The grower soon discovered that tomatoes could be grown satisfactorily in almost any glasshouse that had adequate ventilation.

It is generally agreed that in pre-war days not more than one-half of the glasshouse area of the country was devoted to tomato culture, whereas under war-time regulations tomatoes are grown for at least six consecutive months in the year on 90 per cent. or more of the total glasshouse area. The pre-war total annual home-grown production of tomatoes was estimated to be about 60,000 tons: it is now more than double that figure and is, in fact, about equal to our pre-war supplies of fresh tomatoes from all sources during the months from April to October inclusive. Flower-growers have adapted themselves well to the change-over; and carnation beds, in particular, have produced very heavy crops of tomatoes. (It is interesting to note in passing that carnations in turn do extremely well after the soil has been cropped for two or three years with tomatoes.)

Non-approved Crops on 10 per cent. of Pre-War Acreage

The preservation of stocks of flowers and other non-essential crops was a matter of controversy. Some growers thought that certain nurseries should be reserved for the purpose. But this course was not adopted for a number of reasons, one being that it was dangerous "to put all the eggs in one basket," in view of the possibility of loss by enemy action. The method adopted for a considerable period was to permit the grower to keep a certain percentage of his 1939 acreage of flowers. But finally it was decided to put all growers on the same basis and to permit the growing of non-approved crops on 10 per cent. of any grower's area under glass. A grower may grow what he likes, except mushrooms, on this 10 per cent. The remaining 90 per cent. must, in the words of the Cropping Order, "be used only for the production of tomatoes, mustard and cress, lettuce, endive, radishes, rhubarb or chicory, or for sprouting seed potatoes, or for raising young plants of tomatoes or vegetables; and tomatoes shall be grown for at least six consecutive months during the year to the exclusion of other crops". The one exception to this cropping is in respect of permanent fruit crops, such as vines or peaches. These may remain planted even though the area exceeds 10 per cent. of the original, but the houses must be undercropped with tomatoes as far as is practicable.

Inevitable Difficulties Labour was an obvious difficulty, but generally speaking, the industry has so far had just enough male labour to enable it to carry on, and the Women's Land Army has supplied much of the balance. At one time lack of fuel seemed likely to cause considerable difficulty, since the annual requirements of the industry run to over half a million tons, but for the most part anthracite and coke are used—fuels which are less difficult to supply than coal.

Fertilizers might well have been a serious problem, because intensive hothouse culture calls for heavy dressings of all kinds—tomatoes, in particular, need ample supplies of potash. Requirements have, however, been met adequately. The supply of insecticides has also caused anxiety, but the minimum needs of most growers have ultimately been satisfied. One serious problem that still remains is that of adequate maintenance and repair of glasshouse structures. This, of course, reflects the lack of raw materials and requisite skilled labour.

War-time Distribution of Tomatoes Following the German occupation of the Netherlands and of the Channel Islands in 1940, maximum prices for tomatoes were fixed in 1941. The price given to the grower was based on a crop of 30 tons to the acre, and margins were allowed for wholesale and retail distribution. So keen was the demand by consumers that tomatoes were not displayed in shops but were kept "under the counter" for favoured customers. This resulted in the most interesting feature of the war-time tomato story, and brought about the distribution schemes of 1942 and 1943.

The Ministry of Food states that the 1942 venture was the first scheme that had been attempted in any part of the world to distribute a highly perishable fruit crop equally over the population. It proved an unqualified success. The growers of the two chief surplus production areas, namely, the Lea Valley and Worthing, voluntarily undertook to sell all their tomatoes through the agency of a Primary Distribution Association which, at the direction of the Ministry of Food, sent the produce to Distribution Committees in deficiency areas. Distribution Committees were formed in other parts of the country also, the whole country being covered by 136 Distribution Committees. Most of them functioned successfully, due to the voluntary co-operation of distributors and growers.

Improved Scheme introduced in 1943 But the experience of 1942 indicated that the scheme would be much more successful if it were made compulsory. With the approval of growers and traders, a compulsory scheme was operated in 1943, and it has undoubtedly justified official expectations. The Primary Distribution Association still functions, but is now fed by four surplus production areas instead of two—namely, Lea Valley, Worthing, Hampton and Swanley. The Distribution Committee of 1942 has been replaced by statutory bodies

known as Tomato Distribution Associations, and the tomatoes of all growers cultivating more than 400 sq. yd. of the crop have come under their control. Equitable distribution to the public has been obtained by grading all retailers. T.D.A's have supplied their retailers with graded allocation cards, and it is an offence for any retailer to receive or sell, and for any grower or wholesaler to supply to any retailer a greater quantity of tomatoes than his allocation cards entitle him to receive or sell.

The 1943 scheme not only gave equal distribution to consumers when supplies were short, but it also found a market at maximum price for good quality tomatoes when supplies were at their peak. A novel and successful feature of the scheme was the institution of a "standard grade," which is interpreted as a guarantee that a package so labelled is of the quality defined by the Order.

Of course the personal relationship that usually exists between grower and salesman is often severed by a distribution scheme such as this. But in other respects the grower's customary method of trading has not been affected. If he was a grower-salesman in normal times he can continue to act as such to the same extent as before; the same applies if he is a grower-retailer.

POULTRY ON THE FARM

Summary of Home Service Broadcast: W. S. Mansfield with Frank Sykes of Warminster, Wilts. and Tom Parker of Fareham, Hants., both large-scale mixed farmers .. March 23, 1944

MR. MANSFIELD would like to have more eggs, but Mr. Sykes, thought the immediate prospects are not very bright. The cow is a more economical producer than the hen, so that poultry will, therefore, still have to make out largely on scraps and swill. Even on the general farm no great expansion can be expected; the necessary feeding-stuffs and labour are not available. Mr. Sykes has had to reduce his flock from 10,000 birds to 2,000, and Mr. Parker now has 1,000 birds instead of 10,000.

Breeding from Good Birds If feedingstuffs become available at a reasonable price, Mr. Parker said he could restore his pre-war numbers within one year. The others were doubtful: incubation is one thing, but the crucial question is the suitability of the stock from which the eggs would come. Mr. Parker met this point by explaining that he had maintained his stock birds and would, therefore, merely change over to rearing pullets for himself instead of for the domestic egg producer. Mr. Sykes thought that the war has had at least one good effect—it has prevented the forcing of birds for at least three generations.

This point, however, did not impress Mr. Parker, possibly because he has always been practically self-supporting and has taken pains to maintain the stamina of his flock. This is how he does it: he keeps only one breed—Rhode Island Reds—selects the best 2,000 pullets, as judged by size and general appearance, and puts them by themselves in slatted-floor houses, providing range. In the second year he picks again—the best 1,000 this time—and mates them in semi-intensive houses; five cockerels to every house of 100, with a run-out of 1 acre of grass. Straw makes suitable

houses and stands up well for many years; indeed, Mr. Parker has some straw breeding pens which have been used for 25 years. For chicks, however, he is particular to provide fresh land each year. He never hatches eggs from one-year-old birds: he prefers hens of three years old.

Mr. Sykes's system is similar. Neither breeder, therefore, as Mr. Mansfield pointed out, had specialized in the manner prevalent before the war, under which stock birds produced eggs for sale to hatcheries selling day-old chicks—if sex-linked the cockerels went to poultry fatteners and the pullets to rearers who again sold them at three or four months to specialized egg producers.

Mr. Parker, unlike Mr. Sykes who would not buy a pullet unless he knew all about it, thought specialization of the kind indicated had enabled poultry-keeping to develop before the war. Economically it was a good thing, although it may have tended to lower the stamina standard of our poultry. Mr. Sykes agreed that the system could be made sound by the development of inspection and control by the authorities.

Range for Vigour Mr. Mansfield then referred to the position of the general farmer. He had great advantages; lots of land and consequently less risk of disease. Theoretically, Mr. Parker agreed, but in practice it does not seem to work out. He obtained his best cockerels from small men with only an acre or two of ground. "The biggest factor in farming," said Mr. Sykes, "is individual attention." All the same, he thought a case could be made out for giving breeding stock fresh ground and range. The pedigree man with little ground could produce a pullet with good record for egg production, but the loss of vigour in pre-war hens was due, he contended, to the fact that stock birds commonly bought had been bred and reared for many generations on land which had become unsuitable. In other words, "the patent mash can't replace the grass fields and plenty of room".

Mr. Mansfield recollected that a similar point was made with regard to ram breeding in the discussion on sheep. Mr. Parker, however, was unconvinced; he had bought all his cockerels from only two places in 20 years and all had turned out well.

Poultry and Soil Fertility But what good are the *poultry* going to do the *farm*? Have they anything to offer the land in return? Mr. Sykes said: "Everything; that's the whole point". Mr. Parker was even more emphatic in the opposite sense; he does not want their fertility, he wants their eggs. He is a farmer, and he thought that many farmers forget that a farm is meant to produce food to keep men and women, and not just animals. They grow turnips to feed the sheep, the sheep are kept to grow the corn, and the corn is fed back to cattle. What he aims at is output, and he was proud to have produced over £100,000 worth of human food last year.

Mr. Sykes, on the other hand, values poultry partly for the fertility they leave behind. With the aid of poultry, he has built up a very poor farm on Salisbury Plain into one of high fertility. Why, he asked, pay £10 a ton for nitrogen when you get it for nothing from a hen, with some phosphate and potash in addition?

Labour Remarking, "I believe Parker is pulling our legs," Mr. Mansfield turned to the subject of organizing labour. Mr. Parker likes, as far as possible, to have the same man on the same job all the year round; one man for incubating and rearing, another for looking after the breeders,

another for the folding units, and another for mixing the food and collecting and delivering the eggs. One man will look after 1,500 birds in 45 folds, or 2,000 hens in slatted-floor houses. Mr. Sykes, as regards folding, works on similar lines, but closes down hatching in summer, preferring pullets hatched in November. This tallies with Mr. Mansfield's own experience: autumn-hatched chickens are reared with less mortality than spring-hatched birds. Mr. Sykes is a summer rather than a winter egg producer, and never keeps his birds a second year. Mr. Parker likes, as with cows, to keep production going as evenly as possible all the year round. As a rule, he employs only men and boys, but Mr. Sykes finds that for certain jobs (excluding the moving of folds) women are more suitable than men.

Vermin As to vermin, Mr. Parker finds that provided everything is kept tidy, there is no trouble with rats. Although farming in a fox-hunting country, foxes to not bother him. Badgers, however, are a menace. Mr. Sykes finds that regular visits from rat-catchers keep the rats down. Other vermin, however, such as carrion crows, have been a nuisance, although not badgers. The fold is a good safeguard against foxes.

Poultry-keeping Mr. Sykes thought that something might be done to start off new people with poultry in folding units after the war. A lot of farmers dislike poultry for themselves, but why shouldn't they allow another man to run his folds over their land? Very little capital would be required, and if disaster ensued the assets would be comparatively easy to realize. Personally, he would be glad to allow anyone to do it on his land for the manurial value alone.

Mr. Parker again demurred, although he favoured a modest beginning. His poultry actually started from 16 hens bought at a sale. He then reared 250 pullets, and next year took £250 for eggs and reared 400 pullets—but that was when wheat could be bought for 18s. a quarter. He would like to help in the direction suggested, but he cannot stand untidiness, and poultry farmers, as a rule, are the most untidy people in the world.

Concluding, Mr. Mansfield said that in regard to the vexed question of eggs and fertility, he was taking a middle course. He thought some people overrate the fertility left behind by poultry; on the other hand, an egg is not the only thing left behind which is not a nuisance. He believes that on much poor, light land, poultry-keeping has a great future and a definite place; also on the small family farm, where labour is not the most difficult problem. It would seem, too, that poultry-keeping on the general farm has a nearer future than specialized poultry-keeping.

SWEET LUPINS

A. W. Oldershaw, B.Sc., N.D.A.

Agricultural Organizer for East Suffolk, 1911-40

PROFESSOR Mangold, a German nutritionist of international repute, states that the non-poisonous sweet lupin was discovered by Continental workers after careful study of millions of individual plants. The non-bitter plants were used as seed, and eventually stocks of yellow and blue sweet lupins were raised. The same authority states that this lupin

does not contain the toxic alkaloids of the bitter varieties of lupin—such as are usually grown in Britain.* The *sweet* lupin is readily eaten by all classes of live stock, whereas only sheep will eat the bitter type—and even with these there are fatalities. Green sweet lupins and sweet lupin silage have been used with good results for sheep, pigs, horses and dairy cows.

The value of sweet lupins is mainly as a rich source of protein. The air-dried seeds of the yellow variety contain 38-43 per cent. of protein (with 39 per cent. of digestible protein), as compared with 22-25 per cent. for peas and beans, and 9-11 per cent. for cereals. The fat content is stated to be 4 per cent. and the soluble carbohydrate 30 per cent. Apparently the sweet blue lupin contains only 27 per cent. digestible protein (but this is not quite certain). Professor Mangold further states that the protein is similar to that of the soya bean.

Klesch, another German writer, states that the yellow variety is better for using green, as it contains a greater proportion of leaf and does not become woody so rapidly. The yield of green food depends mainly on sufficient soil moisture during April–June. Seed yield in a good year would be about 1 ton per acre—in dry seasons only one-third to half a ton. Requirements of cows up to 3 gallons of milk can be met with a diet of lupin silage and hay.

Professor Woermann (1937) recommends growing sweet lupins on light and medium soils, mainly for use green and as silage ; the making of lupin hay is difficult. Other German writers speak of yields of from 22 tons of green material per acre under good conditions with ample rainfall, to 8–9 tons in a dry season, and it is claimed that the yellow variety is of higher feeding value than the blue, whether used green for silage or as grain.

New Zealand Experience During the past few years a small area of sweet lupins has been grown in New Zealand. A bulletin prepared by Canterbury Agricultural College, Lincoln, New Zealand†, dealing with the fattening of lambs on sweet blue lupins, states that stock thrive upon the yellow lupin, but under Canterbury conditions it is not a good enough grower to justify its use. Black and Claridge‡ suggest, however, that the slow growth of sweet yellow lupins may not be so apparent in the warmer parts of the North Island. The sweet blue variety, however, has proved highly satisfactory ; sheep and lambs eat it readily, and no cases of lupin poisoning have occurred.

For the fattening of lambs, rape has been the most important crop in New Zealand up to the present.

In a preliminary experiment on the Lincoln Agricultural College farm bitter blue, sweet blue and sweet yellow lupins were compared as sheep feed. All the sheep were supplied with more food than they could eat for a period of 23 days. The hoggets on the sweet yellow lupins gained 6.2 lb. in live weight, those on the sweet blue 4 lb. and those on the bitter blue only 0.9 lb.

In another experiment at Canterbury, N.Z., sweet blue lupins were compared with rape, as sheep feed, precautions being taken to ensure a fair distribution of lambs on three equal plots of rape and three equal plots of sweet blue lupins. The total liveweight increase of the lambs on the 3 acres of rape was 595 lb., and of those on the 3 acres of lupins 1,068 lb. No deaths occurred with either treatment. The investigation had particular reference to the cultivated lands of Canterbury, N.Z.

* Earlier articles by Mr. A. W. Oldershaw on the *bitter* lupin have appeared in this JOURNAL (1920) **26**, 982; (1925) **32**, 316; (1941) **48**, 164.

† Bulletin No. 154.

‡ *New Zealand Jour. Agr.*, August 15, 1942.

Neither the plants nor the seeds of the sweet blue variety can be distinguished externally from the bitter blue, so that to protect purchasers sweet lupin seed has been certified.

Another leaflet (published by Wright, Stephenson and Co., of Christchurch, N.Z.) states that sweet lupins should not be grown on land which has been cropped with bitter lupins for at least three years. (The writer does not know whether the variety of sweet yellow lupin grown in New Zealand is the same as that of which we have a small stock in this country.)

In considering the New Zealand results in their application to conditions in Britain, it is noteworthy that the whole of the North Island and most of the South Island have a rainfall of more than 30 in., and a considerable area has more than 50 in. The Canterbury plains, however, where these experiments were conducted, have a rainfall of less than 30 in.

Sweet Lupins in England A few years ago a small quantity of sweet yellow lupin seed was sent to the writer by the National Institute of Agricultural Botany at Cambridge for trial at Tunstall. A few hundred square yards were sown and the crop made good growth, the seed being harvested. Since then the stock has been gradually increased, with consistently successful results; in 1942 there was enough seed to sow the rotation plots. The soil on which these rotation plots are situated is a light sand with an original lime requirement of 27 cwt. of carbonate of lime and a *p*H of 5.8. In 1926 half of this field received 5 tons per acre of soft lump chalk; the other part remains unchalked. Crops such as sugar beet and barley succeed on the chalked land, but are a total failure on the unchalked part. The sweet yellow lupins in 1942 grew equally well on both the chalked (which is now neutral to slightly acid) and the unchalked part (which is now very acid). In 1943 a fair crop was grown in both fields at Tunstall, in spite of damage by blowing sand in one field just when the crop was coming up, and later a very severe drought. In the field with the lightest soil one unchalked strip is very acid, but this did not appear to diminish the crop. This same patch is now under rye, which looked yellow in March and much worse than the rest of the field—a fact which seems to indicate that the capacity of sweet lupins to resist soil acidity is greater than that of rye. The following Table gives the 1942 yields of sweet yellow lupins and the 1943 yields of sweet lupins and of Lincolnshire small blue peas on different quarter-acre plots in the same field under identical conditions:

Experiments at Heath Walk, Tunstall

		Yield per Acre	
1942	Sweet yellow lupins ..	Plots in duplicate and bulked. No apparent difference between chalked and unchalked. Average yield—17 cwt. 1 st.	
		Land Chalked in 1926	Unchalked
1943	Sweet yellow lupins ..	7 cwt. 2 st.	8 cwt. 3 st.
	Lincolnshire small blue peas	7 cwt. 5 st.	Complete failure owing to acidity.

The drought of 1943 was so severe in Suffolk that many fields of peas were folded green or cut for hay, as there was no prospect of an appreciable yield of grain. Crops on light land suffered more from drought probably than in any season during the past 20 years. The small yield of sweet lupins in 1943 cannot therefore be regarded as in any way typical. The extreme drought was also responsible for very small yields of several other crops on light land in Suffolk—potatoes, carrots, swedes, turnips and late-sown barley.

Sweet yellow lupins from Tunstall stock were also grown in Suffolk in 1943 on the sandy soil of the Broxted Estate, which belongs to Messrs. R. H. and R. Paul (Mr. E. J. Gaymer, agent), and produced a fair crop in spite of the drought. Mr. Gaymer (who is also Executive Officer to the East Suffolk War Agricultural Executive Committee) is growing 17 acres this year, besides 12 acres of sweet blue.

A small quantity of seed was tried experimentally at other centres in England in 1943 to ascertain the conditions under which the lupins would thrive. The presence of an abundant supply of lime in the soil resulted in complete failure (Norfolk and Cotswolds). In Derbyshire, Mr. H. E. Wells sowed a few sweet yellow lupins in a grass mixture on reclaimed land about 1,300 ft. above sea-level, with the idea of growing an extra bite where the land is reseeded to grass direct. A little soil from Tunstall was mixed with the seed to provide nodule organisms. The lupins came along very well at first, but later growth was rather slow. It is doubtful whether they are suited to such a very bleak district.

On the whole it may be said that sweet yellow lupins have been successful in the past few years where:

i. the soil was light, with an acid or neutral reaction;
ii. the crop was kept reasonably free from weeds; and
iii. sowing took place early enough to enable the seed to obtain sufficient moisture for germination and subsequent growth; this was very marked in the exceptional drought of 1943.

Description of Plant When sufficient moisture is present in the soil the sweet yellow lupin will grow to a height of 3 ft. or so. It produces numerous branches near the ground, differing in this respect from the bitter blue lupin. It appears to be more robust than the latter plant, and leaves behind more root and leaf residue. The tap-root penetrates the soil deeply and has on it numerous nodules. It is not known whether soils in other parts of the country contain the proper micro-organisms to cause the development of nodules. In Suffolk, bitter lupins have been a common crop for many years, and the soil undoubtedly contains the right type of nodule organism.

Varieties German writers favour the yellow sweet lupin, which is stated to be of higher feeding value than the blue, whether used green or dried, as silage or as grain. A strain called "Welko" was referred to in 1938 as having a higher digestibility. On the other hand, New Zealand growers, finding that the yellow variety grows too slowly under their conditions, express preference for the blue. No information is available as to the value of sweet blue lupins in this country, but a small quantity of the seed obtained from New Zealand has been drilled this season, and is coming along well.

Cultural Details The methods of cultivating sweet yellow lupins are similar to those for spring beans, and it is useless trying to grow them on foul land. Although lupins are supposed to suffer from spring frosts, this has never happened with us in Suffolk. Self-sown sweet yellow lupins survived the mild winter of 1942–43 and produced seed the same year. When intended for seed, it is probably best to drill during April—the earlier in that month the better. When intended as a green crop or for folding, drilling may take place any time up to the end of June, or even later provided there is sufficient moisture in the soil to germinate the seed and provide for growth. In dry weather late-sown lupins suffer

from mildew. In Suffolk we have always succeeded in obtaining seed of very good germination. Of such seed we think 6 stones per acre is sufficient, drilled in rows 14–18 in. apart. In view of the branching nature of the plants and the scarcity of seed, 5 stones per acre of very good seed if probably enough. The seed should be drilled on a firm seedbed about 1 in. deep and the land harrowed about 4 days later to kill seedling weeds, especially spurrey, which is often a pest on land suitable for lupins. Is possible the lupins should be harrowed when 3 in. high and horse-hoed twice. They grow slowly in the early stages, and are easily crowded out by weeds. The only manure which has had much effect upon lupins at Tunstall has been the residue of farmyard manure applied one or two years previously.

The crop should be cut for seed when slightly on the green side. If allowed to get dead ripe it is likely to shed badly. The bushy habit of growth of sweet lupins makes them difficult to cut with a binder. Very good work can, however, be done with a side-delivery reaper or a grass mower. With the latter, the heel-board should be set to make as wide a path between the swathes as possible. The crop is then carted loose.

If put in a narrow stack the wind will be able to penetrate the crop, and so greatly improve its condition. For seed purposes sweet lupins are best left unthreshed until February or March; by this time they will have had ample time to dry in the stack, and the risk of their going mouldy or heating in the sack after threshing is reduced.

Soil, Rainfall and Acidity Light soils which are either neutral or somewhat acid in reaction appear to be the most suitable. In the very dry summer of 1943 a lime requirement of 30 cwt. carbonate of lime on a light sandy soil did not injure them: there is little doubt that a high lime content in a soil is almost certain to cause failure.

Although, given sufficient moisture, the crop thrives on blowing sand of the poorest type, it appears probable that a larger crop of greenstuff could be grown on a light loam. As a forage crop, a reasonable summer rainfall is desirable. It is quite possible that the heavier rainfall of western Britain would suit lupins as a forage crop better than the extremely dry conditions which so often prevail in the eastern counties. Irrigation would undoubtedly double or treble the crop of green material on a typical lupin soil in Suffolk in a dry season.

For seed production it is likely that light sandy soil with a rather low summer rainfall is best to hasten ripening. The 1943 season, however, was much too dry for normal growth. On our light sand at Tunstall the crop drilled in mid-April has always been fit to cut for grain by the end of August, even in a late harvest.

As Stock-feed in England:
FOLDING THE GREEN CROP

An experiment on the folding of sweet yellow lupins at Hinton Hall Farm (East Suffolk W.A.E.C.) was conducted under the supervision of Mr. F. Peecock, Cultivations Officer, and Mr. Wick, Foreman. The soil of the field on which this experiment was conducted is extremely light—in fact, mainly sand. It has been chalked and is now neutral. Four acres were drilled with seconds sweet yellow lupin seed at the rate of 1½ bus. per acre on May 24, 1943 (first-class seed was not available in sufficient quantities). Next morning 3½ lb. per acre of rape seed was broadcast. A small shower of rain had fallen before drilling, but until then the soil had been extremely dry. Very little rain fell subsequently. Ninety-nine lambs (Suffolk × Lincoln) folded the crop,

receiving in addition ½ lb. of a mixture of oats and peas per head daily. The sheep liked the lupins and, indeed, preferred them to the rape—which they left until last—and the flock never left the field until the crop was finished on September 1.

Owing to drought, the crop was not 1 ft. high when folded, but the pods were quite large. During the nineteen complete days of the folding there was no sign of "blowing" or poisoning amongst the sheep; in fact, none of them was in any way adversely affected. It was considered that the period of the experiment was long enough to determine whether the food had any poisonous or detrimental effect upon the sheep, but hardly long enough for the live weights of the sheep to furnish any useful information. Unfortunately circumstances did not allow the sheep to be weighed when they went off the crop.

FEEDING THE GRAIN Only a very small quantity of grain was available for experiments on the feeding of animals, but the following is a brief account of the limited work which was possible. (The writer is indebted to the Ministry's Veterinary Laboratory, Weybridge, for this report.)

Composition of Lupin Grain

	BITTER BLUE LUPINS *per cent.*	SWEET YELLOW LUPINS *per cent.*	*SWEET YELLOW LUPINS *per cent.*
Total Alkaloid (as lupanine)	2.2	0.5	Not estimated
ANALYSIS			
Moisture	13.3	11.5	10.78
Ash	2.5	4.3	4.60
Crude protein	28.1	41.9	37.63
Ether extract (fat, etc.)	5.3	5.8	4.05
Crude fibre	12.1	12.9	15.12
Nitrogen-free extractives	38.7	23.5	27.82

* Analysis by Mr. E. T. Halnan, M.A., of another sample.

Small-scale feeding trials at Weybridge gave the following results:

(1) Experiments with rabbits and poultry showed that the toxicity of the contained alkaloids was much lower than commonly supposed.

(2) A cow (not in milk) received varying quantities of crushed seed. The results suggest that it would be quite safe to feed up to 5 lb. of sweet yellow lupin seed per head per day to adult cattle not in milk: in view of the high percentage of protein, it is unlikely that anyone would wish to feed more. It would be desirable to extend these observations to milking cows. The toxicity is very low, and there is no doubt that sweet lupin seeds could safely be included as a fair percentage of compound feedingstuffs.

Poultry Mr. E. T. Halnan, M.A., of the School of Agriculture, Cambridge, has kindly consented to the publication of the following:

"On December 6, 1943, we put 10 eight-weeks-old pullet chicks which had been reared from day-old on the National Baby Chick food on the same mash to which 15 per cent. of sweet yellow lupin seed meal had been added. The birds were reared in a Gloucester Battery Brooder. They were allowed mash *ad lib.* in dry form. The average weight of the chicks on December 6 was 817 grm. The trial finished on December 20, when the average weight of the chicks was 1,052 grm. During this period each chick ate 1,416 grm.

of mash containing 212.4 grm. of lupin seed meal. The birds kept in excellent condition throughout, grew well and ate well.

I am satisfied that the sample of yellow lupin seed you sent is a satisfactory feedingstuff for use in poultry foods, both for chicks and older stock, at least when fed up to a 15 per cent. level."

Preliminary feeding trials have been carried out by the Animal Husbandry Department of the Royal Veterinary College on pigs, and in conjunction with the University of Reading Farm at Sonning, on poultry. These experiments were intended primarily to determine the safety or otherwise of feeding sweet lupins, and at the same time to indicate whether the lupin meal would be generally suitable for feeding purposes.

The writer is indebted to Professor W. C. Miller and Mr. D. J. G. Black for the following short account of the results obtained:

"The poultry experiment was too restricted to be conclusive, but within its limitations it shows that under the conditions specified this sample of sweet yellow lupin meal (ex Tunstall) had no harmful effects when fed at 11 per cent. and 20 per cent. of the mash fed."

Analysis suggests that the protein value of sweet lupins is about twice that of pea meal.

Pigs (at Royal Veterinary College) "A preliminary trial showed that the sweet yellow lupin meal had no toxic effects on 5 pigs receiving it at the rate of 10 per cent. of the ration. The palatability was good, digestion normal, and the pigs gained in weight, growing at a rate not significantly different from litter mates receiving the same basal ration, but 10 per cent. pea meal instead of the lupin meal. All the experiments on feeding animals have been short-term, and as soon as larger amounts of seed are available, it will no doubt be desirable to ascertain whether feeding lupins for a prolonged period has any deleterious effect."

In view of the large area of light acid land in this country, there appears every reason to believe that sweet lupins may prove a valuable crop on such land, and may help greatly to increase its stock-keeping capacity and improve its fertility. It is regretted that there is at present insufficient sweet lupin seed for general distribution, but it is hoped that greater supplies will be available next year.

In conclusion, the writer wishes to express his thanks to those whose names are mentioned in this article, particularly to those who so kindly conducted experiments in feeding animals with sweet lupins grown at Tunstall. Especially are thanks due to Dr. E. G. White, who placed a summary of German work at the writer's disposal and made arrangements for the experiments at the Royal Veterinary College.

Note: Growers requiring sweet lupin seed for 1945 should inquire of their normal seed supplier several months before they require it.—Ed.

THE CARE OF MOWER KNIVES

National Institute of Agricultural Engineering, Askham Bryan, York

Sharpening It is most important to keep mower knives sharp. Blunt knives cause a large increase in draught, poor cutting, and excessive wear on the rest of the mower. Always have a sharp knife ready and change as soon as the one in use loses its edge. (As a guide, a sharp knife is usually needed after about two hours work; often less.)

In sharpening the knife sections, take great care to maintain the original slope of the bevel at the cutting edge, taking the same amount off the full length of the section. If this is not done the angle of cutting will be changed, and poor work will result.

Sections Replace at once any sections that are badly damaged. It is false economy to attempt to use them further. All sections should be in line; any that are not can be adjusted with a light hammer.

Rivets Look over the knife each time it is sharpened to see that all rivets are tight. Any that are slack in their holes must be replaced by a larger size; this is especially important on the knife head. When riveting sections leave a good "burr" on the rivet, never hammer it flat, unless it is countersunk.

Fingers Sharp fingers are as essential as a sharp knife for efficient cutting. The edges of the fingers should be square and sharp. Most types of fingers can either be ground on both sides to produce a square edge or have new ledger plates fitted.

Lubrication Lubricate the pitman bearing on the knife head frequently and thoroughly to prevent excessive wear. Slackness in this bearing will lead to loss of motion in the knife. Never lubricate any other parts of the cutter-bar.

CO-OPERATION IN FOOD PRODUCTION

ALTHOUGH the English people, as a whole, are not perhaps so co-operatively minded as some of their Continental neighbours, there are few activities to-day (either of labour or leisure) where some form of co-operation cannot be found. In the sphere of food production the most favourable ground for co-operation exists among amateur food producers, the vast majority of whom have little or no experience, but an abundance of enthusiasm. Three organizations in this field, the Small Pig Keepers' Council, the Domestic Poultry Keepers' Council and Village Produce Associations, all of them under governmental direction, have made considerable progress during the war and, as the following short accounts of each clearly show, are making an extremely valuable contribution to our home-grown food supplies.

Small Pig Keepers' Council The Small Pig Keepers' Council was set up at the request of the Minister of Agriculture shortly after the outbreak of war. It is a semi-independent body representative of many organizations and interests concerned with

pig-keeping on efficient and economical lines through the organization of pig clubs. Cottagers, allotment-holders, and others, are encouraged to assist the food production effort by utilizing kitchen and garden waste, especially in rural areas where a public salvage collection cannot be arranged, by joining together to keep a few pigs. The pig club member has an advantage over the domestic pig-keeper outside the club in that feedingstuffs and other necessities can be purchased in bulk and therefore more cheaply, and members are able to exchange information and experiences to mutual advantage. To these benefits the Small Pig Keepers' Council has added various insurance schemes and many other administrative and advisory services, including the issue on behalf of the Ministry of Agriculture of an allowance of rationed feedingstuffs on a slightly more generous scale than is available to unorganized domestic pig-keepers.

Nearly 5,000 Registered Pig Clubs

The Council began work in November, 1939, with the aid of a skeleton staff and a small Government grant. The rapidity with which the scope and volume of the work increased can best be illustrated by reference to the subsequent grants paid and the numbers of active clubs on the register of the Council at the end of each of the periods concerned:

	Grant Paid £	No. of Active Clubs
June, 1940—March, 1941	2,700	735
April, 1941—March, 1942	5,310	2,308
April, 1942—March, 1943	9,000	4,230
April, 1943—February, 1944	10,824	4,863

There are now nearly 5,000 registered pig clubs—more than ten times the number formed in the last war—with a membership of more than 150,000. About 10,000 tons of pig meat are produced a year, of which a substantial part is sold to the Ministry of Food.

So far the administrative and other expenses of the Council have been met largely from Government grants, but the ultimate aim of financial independence has always been borne in mind. The Council is at present considering how its financial self-sufficiency can best be attained, but in the meanwhile a small but growing income is being derived from subscriptions from registered clubs and from insurance commissions.

Apart from the work of organization referred to above, and the dissemination of propaganda and guidance in the form of advisory leaflets and news-letters, a staff of regional officers has been responsible since 1942 for the local supervision of club activities. The work of the regional staff includes the promotion of new clubs and the provision of advice and help for those already established. Much has been done to assist the Ministries of Agriculture and Food in the application of their regulations. A technical officer has also been available to advise on problems of pig management.

In collaboration with the Ministry of Agriculture, the Council has recently launched a campaign of instruction in the best use of the pig when slaughtered, including the revival of the art of home-curing of bacon. Demonstrations are being organized up and down the country, and literature on the subject, in the form of leaflets and a recently published bulletin,* is in considerable demand.

*Bulletin No. 127, *Home Curing of Bacon and Hams*, obtainable from H.M. Stationery Office, price 1s. 3d. net (1s. 5d. by post).

Among other immediate activities are the promotion of more pig clubs among agricultural workers and the enlistment of more domestic pig-keepers into the pig club organization, partly as a means of relieving the rationing work of the County War Agricultural Executive Committees.

AFTER THE WAR It is worthy of note that some of the clubs have been in existence ever since the 1914–18 war, while yet others have had an unbroken existence for a much longer period. Pig clubs are not, therefore, an innovation called into existence by war-time conditions, and the vitality and enthusiasm to be found in many of them suggest that they will not quickly disappear, particularly in rural areas. Domestic pig-keeping has always held a recognized place in British rural economy, and the conversion of waste food into pig meat by domestic pig-keepers may be expected to provide, personally and nationally, a valuable contribution to food supplies, particularly in the immediate post-war years.

The absence of any co-ordinating organization was undoubtedly a factor contributing to the decline in domestic pig-keeping after the last war, and it seems clear that while certain advantages derived from the pig club movement would remain in any event, after the present war many pig-keepers who have experienced the useful services rendered by the Small Pig Keepers' Council will wish the Council to continue to provide help and guidance to clubs and their constituent members.

Domestic Poultry Keepers' Council Prior to 1939 it is estimated that approximately 250,000 householders kept laying poultry. Egg production was not the sole aim of these poultry-keepers ; many were "fanciers" to whom eggs were secondary to the hobby of showing. After the outbreak of war many more people started to keep poultry, and the first indication of their number was given in February, 1941, when rationing of feedingstuffs was introduced and applications for rations were received from 791,000 persons. The additional half million poultry-keepers almost certainly bought their stock and equipment to ensure for their households a regular supply of eggs. A large number, if not the majority, of these newcomers were probably ignorant of the basic principles of good management. Advice and guidance were therefore essential if they were to get the best out of their stock and, in particular, make effective use of household and garden waste as well as of any purchased feedingstuffs. It was with this object that the Domestic Poultry Keepers' Council was appointed in September, 1940.

INTRODUCTION OF BALANCER MEAL One of the first tasks of the Council was to make available for domestic poultry-keepers a sufficient supply of feedingstuffs of a kind suitable, when fed together with the kitchen waste, to form an adequate diet for the hens. The Council was informed that all concentrated feedingstuffs would have to be rationed. With expert advice, a formula was evolved for a meal, based on ingredients available under war-time conditions, which would ensure a balanced diet and reasonable egg production when mixed with kitchen waste. The meal was called "balancer meal," and in conjunction with the Ministries of Agriculture and Food, arrangements were made for its distribution to domestic poultry-keepers, commencing in February, 1941.

At the outset rations of balancer meal were allowed for the actual number of birds kept up to a maximum of 12 birds per household. In the

summer of 1942, however, with the feedingstuffs supplies position generally continuing to deteriorate, it was decided that persons keeping poultry should not be allowed also to buy shell eggs in the shops, and that balancer meal rations should be supplied only in return for shell egg registrations surrendered. From October 1st, 1942, a ration of balancer meal, sufficient with kitchen waste to maintain one bird, has therefore been allowed for each shell egg registration surrendered by domestic poultry-keepers. The ration was increased from 4 to 5 lb. of meal per month as from June 1st, 1943, in recognition of the diminishing quantity of household waste available where proper economy was exercised.

There are now some 1,200,000 registered domestic poultry-keepers and approximately 5½ million shell egg registrations have been surrendered by them. The total production of eggs by these domestic poultry-keepers no doubt exceeds 600 million per annum.

RABBITS In the summer of 1941 the Council was asked to undertake also the work of providing advice for domestic rabbit-keepers. Tame rabbit-keeping on a domestic scale forms a useful adjunct to the nation's larder. Rabbits can thrive on kitchen and garden waste and on a large variety of greenstuffs including weeds; the only demand on rationed feedingstuffs is a small quantity of bran required for breeding does. Bran rations are therefore allowed for each doe, up to a maximum of four, kept by a domestic rabbit-keeper. The number of rationed does kept by domestic rabbit-keepers is now 186,000 and the total production of meat from the progeny at a modest estimate may be put at 30,000 cwt. per year.

As already indicated, it was in February, 1941, that the need arose for organizing the work of providing advice and assistance for domestic poultry-keepers, and the Council accordingly appointed a Central Organizer (Honorary), an Assistant Central Organizer, and twelve full-time Area Organizers. When, shortly afterwards, some guidance was needed also on domestic rabbit-keeping, the organization was expanded by the appointment of 13 Assistant Area Organizers.

TECHNICAL ADVICE Better backyard food production could be secured only by individual help in technical problems; personal contact between the Area Organizers and every poultry-keeper was obviously impracticable. The recruitment was therefore undertaken of a band of voluntary helpers, and these now number 442 "Sub-Area Organizers," supported by 2,507 "Front-line Organizers". Sub-Area Organizers take charge of whole districts, and the Front-line Organizers, working under the Sub-Area Organizers, are responsible for organization in villages or groups of streets in towns.

Instruction is most readily made available through clubs, and the formation of further clubs is still the major task of the Organizers. The aim is that every poultry- and rabbit-keeper shall have available in his immediate vicinity someone to whom he can turn for help when in difficulties. There are now 2,079 poultry clubs. The Council's officers have addressed over 11,000 meetings and given 10,000 lectures, demonstrations, film and lantern shows.

This work has been supplemented by the distribution of copies of five simple leaflets; four for poultry, dealing with feeding, housing, stock and simple ailments, and a comprehensive leaflet covering rabbit meat production.

Important Factors in Domestic Stock-keeping Three factors in particular influence successful stock-keeping : correct feeding, proper housing and the purchase of good stock. On feeding, there is one important point which the Council's officers will continue to try to correct—it is over-enthusiasm. This is shown by a tendency for some poultry-keepers to keep more birds than the available feedingstuffs will support. Under-feeding is responsible for many of the reported failures to obtain good egg yields. The Council's policy is "more eggs from fewer hens".

Good housing is now general in spite of a shortage of building materials. Overcrowding still exists, but will right itself when the reduction in numbers of birds needed to avoid underfeeding is achieved.

The importance of good stock cannot be too strongly emphasized. If good birds are bought in the first place disease and ailments should cause little trouble. Domestic poultry-keepers are being urged to buy birds not less than eight weeks old. The average domestic has neither the skill, appliances nor feedingstuffs to undertake the task of rearing up to eight weeks of age. To assist breeders to meet the demand for good laying stock, special allocations of feedingstuffs have been made to accredited breeders who undertake to rear stock for sale to small poultry-keepers at prices agreed by the breeders' representatives and the Council. These breeders should be able, on the special rations allowed to them, to rear a large proportion of the pullets for sale at well over eight weeks, and the agreed price scale provides for pullets up to 20 weeks of age. It is estimated that by August of this year well over one million pullets will have been reared under this scheme.

Outstanding problems of rabbit-keeping are similar and are being tackled in the same way. Too little food for too many animals, overcrowding, and the use of too small hutches prevent maximum meat production. Good progress is being made, and with increasing numbers of demonstrations, film shows and radio talks there is every reason to expect a much higher level of achievement in the coming year than in any of the earlier years of the war.

The cost of the work of the Domestic Poultry Keepers' Council for both poultry and rabbits was £1,545 for the period from September, 1940, to March 31, 1941, £19,562 for the year ended March 31, 1942, £30,150 for the year ended March 31, 1943, and approximately £28,000 for the year ended March 31, 1944.

Village Produce Associations Briefly, these Associations are "clubs" set up in rural and semi-rural areas with the object of making such districts as nearly self-supporting as possible in those foodstuffs which can be produced in the garden and allotment. This involves wise planning in the cropping of vegetables and the encouragement of mutual help among the community. Originally, the interests of Village Produce Associations were confined to the production of vegetables and fruit, but subsequently they were extended to include rabbits, poultry, pigs, goats, bees, etc. Mutual help between gardeners and small livestock-keepers means on the one hand increased fertility of garden and allotment through larger supplies of manures, and on the other the full use of vegetable waste to supplement feedingstuffs for animals. Associations may buy in bulk such things as seeds and fertilizers to the financial benefit of their members, and they may also assist in the *local* disposal of surplus produce.

Not least, the Associations form convenient village centres, through which technical and practical advice can be obtained on all branches of domestic food production. Returns made in September, 1943, showed a total of over 1,500 Associations, and their number is still increasing.

No grants from the Exchequer are made to Village Produce Associations. They are entirely self-supporting; indeed, many of them pay affiliation fees to their County Garden Produce Committees, the parent organizations. The County Committees, however, are in receipt of grants from the Exchequer to meet their administrative expenses. These grants amounted to £3,460 in 1941–42, £3,650 in 1942–43, and approximately £5,400 in 1943–44.

It should be noted that the scheme for Village Produce Associations does not extend to the larger urban areas throughout the country. In those areas the responsibility for encouraging and stimulating the cultivation of gardens and allotments and for local participation in the national "Dig for Victory" campaign rests with the local authorities, most of whom have set up Horticulture Committees for this special purpose and made arrangements to provide technical advice on cultural matters.

A fuller account of Village Produce Associations and their work was given in the October, 1943, issue of this JOURNAL.

FARMING NOTES

Summer Liming of Grassland Lack of lime in the soil is reflected in the health of both man and beast. Some few crops, such as potatoes, oats and rye, are tolerant of a slight degree of lime deficiency, but the majority need an ample supply if they are to do well and pass on their nourishing qualities. Grass ranks high among the latter, for upon the herbage of our pastures, whether grazed or converted into hay or silage, depends the calcium required by stock, particularly young stock and milking cows, for making bone and milk. Side by side with the establishment of new leys, older grassland can be improved in feeding quality by a summer dressing of lime. Two to three tons per acre (broadcast) of coarse ground limestone, limestone dust or ground chalk, will greatly improve meadows and pastures known to be markedly deficient in lime. On less acid pastures, a smaller dressing of the quicker-acting finely ground limestone will produce richer and more palatable grazing. Such dressings can be supplied to meadows as soon as their hay crop has been cleared, and to pastures at any time when the grass is short; stock should, however, be kept off the treated pastures until rain has washed the herbage clean.

Salted Hay Saves a Day Where haymaking is concerned, time is the all-important consideration. We have to catch the crop at just the right time, and praying that good weather will attend our efforts, proceed to make it and get it into the stack without loss of colour or loss of leaf, so that its full nourishment can be carried over to the winter months. At any time during the haymaking operations circumstances beyond the farmer's control may supervene to spoil the crop. Therefore the sooner the crop can be carried without undue risk of subsequent fermentation in the stack, the better.

This is where the use of salt comes in. Its value as a preservative with other and human foodstuffs has, of course, been recognized from time immemorial; its adoption in the haymaking technique is much more

recent and, for that matter, is still in a tentative stage. However, it can be said with confidence that a sprinkling of ordinary agricultural salt at the rate of 20 lb. per cart-load of crop during stacking *does* enable hay to be carried safely as soon as it rustles but is still "tough". Thus the period of exposure, whether to sun or rain, may be shortened by about one day—and one day in catchy weather may, as everyone knows, make all the difference between good hay and rank bad.

The swath should be turned, or preferably shaken up lightly, as soon as the top is outwardly dry. Then leave for about 12 hours and turn again. As soon as the whole lot is what might be considered three-quarters dry, the crop is ready for stacking. As each load or haul is shaken over the stack, broadcast the salt over each layer. Twenty pounds per load is a reasonable quantity for meadow hay, but clover or other succulent hay may need double that amount.

Salt does not entirely exclude the risk of heating in the stack, but it certainly reduces it to a minimum and prevents the formation of mould and the aggregation of dust. Salted hay seems to be most palatable to stock, and thus waste in the rack or in the field is insignificant. For stock wintered out, salted hay is best fed in small bunches distributed over the pasture, and the usual salt lick can be dispensed with.

Insurance of School Children in Agriculture School children did some valiant work last year on our farms, and this year we hope to see more of them helping with the harvest. They will be well organized and well cared for, but for all that accidents may happen. How does the farmer stand in such an event ?

The liability of a farmer-employer under the Workmen's Compensation Acts or at Common Law extends to all his employees. If he intends to employ school children he should make sure that they are covered by his insurance policy. If the compensation payable by the farmer under the Workmen's Compensation Acts is less than would be payable under these Acts to a person of the same age and sex employed full-time in agriculture at the statutory minimum weekly wage sustaining the same injury, the Ministry of Agriculture will pay the difference between these two sums. For compensation purposes, the Ministry of Agriculture will treat schoolboys and schoolgirls of 12 or 13 who help in agriculture as though they were 14 years of age and were earning the statutory minimum weekly wage.

In addition, the Ministry of Agriculture is prepared to meet the reasonable certified cost of medical expenses of schoolboys and schoolgirls who may be injured while working in agriculture, provided that they are not recoverable from any other source.

Low-grade Fertilizers Shortage of certain fertilizers tempt many people to try substitute materials, but it cannot be stressed too strongly that, apart from lime, the only known fertilizers in general use contain nitrogen or phosphoric acid or potash or combinations of these. Any so-called fertilizer that does not contain at least one of these constitutents will inevitably involve the purchaser in unnecessary expense and waste of time. Farmers should not buy types of fertilizers new to them until they are completely satisfied that they are obtaining real fertilizer value for their money.

The Fertilizer and Feedingstuffs Act, 1926, requires, in the case of the principal fertilizers scheduled under the Act, that the seller shall give a statutory statement as to the amount of nitrogen, phosphoric acid and potash, and this statement has the effect of a written warranty by the seller that the particulars given are correct. When there is any doubt send a sample for analysis to the Official Sampler appointed by the County Council or County Borough, or consult your War Agricultural Executive Committee.

Ammoniated Sugar-beet Pulp Recent experiments in the U.S.A. suggest that sugar-beet pulp treated with ammonia can provide a nitrogenous feed for ruminants and is a relatively simple and inexpensive process.

H. C. Millar, of the Quaker Oats Company Research Laboratories, writing in the March issue of the *Journal of Dairy Science*, describes the experimental feeding of ammoniated sugar-beet pulp to seven Holstein bull calves. Following a preliminary feeding of milk, calf meal, lucerne, and molasses beet pulp, the animals were placed on a diet prepared by adding 15 lb. of ammonia to 300 lb. of pulp, in an ammoniation unit which was revolved for 30 minutes and gave a product containing 25–27 per cent. protein. Unammoniated pulp was then mixed with the ammoniated pulp to give the necessary protein value for the rations. Two of the calves were initially kept on a basic ration which contained no ammoniated pulp. In all cases the animals appeared to find the diet palatable. Each calf consumed 5 lb. of feed early in the experiment, and later this amount was gradually increased until after 34 days 12 lb. were being eaten. After 70 days, the amount was further increased to 15 lb. which, however, proved too much and was decreased to 11 lb. for the rest of the experiment (225 days).

No digestive troubles developed in any of the animals. The two calves on the basal ration exhibited marked protein deficiency after 60 days; they ceased to grow, became thin, developed a sharp-boned hump on the back, a pot belly, a rough and shaggy coat and a listless gait. After changing over to an ammoniated pulp diet, however, they started to lose their protuberant bellies, their backbones straightened out, their coats improved, they became more lively and they began to grow at the rate of 2 lb. per day. On slaughter, the meat of all the animals was found to be normal in colour and flavour. The results of this experiment indicate that the animals were using the ammonia added to the dried beet pulp for their protein metabolism.

Strawberries and Raspberries: Certification Arrangements have again been made this year for the certification of strawberry stocks which are found on inspection to be true to variety, and which attain the prescribed standard of apparent freedom from disease. Growers wishing to have their stocks inspected under the Scheme should apply (preferably by post-card) to the Ministry's offices at Berri Court Hotel, St. Annes-on-Sea, Lancs., for details and a form of application. Completed application forms must be returned to that address by July 15, 1944, in the case of growers in Cornwall, Devon, Dorset, Gloucester, Hereford, Somerset and Worcester, and by August 12, 1944, in the case of growers in other parts of the country.

A scheme for the inspection and certification of raspberry plantations has also been inaugurated. For the first year it will be confined to one variety, "Norfolk Giant". Details of the scheme and an application form can be obtained from the above address, to which all completed forms must be returned by August 14, 1944.

THE MINISTRY'S PUBLICATIONS

Since the date of the list published in the March issue of this JOURNAL (p. 575) the undermentioned publications have been issued:

Bulletins Copies are obtainable at the price mentioned from the Sales Offices of H.M. Stationery Office or through any bookseller.

No. 21 Domestic Preservation of Fruit and Vegetables (*Revised*). 1s. 6d. net (1s. 8d. by post).

No. 124 Composition and Nutritive Value of Feeding Stuffs (*Revised*). 6d. net (7d. by post).

Advisory Leaflets Single copies of not more than 16 leaflets may be obtained, free of charge, on application to the Ministry, Berri Court Hotel, St. Annes-on-Sea, Lancs. Further copies beyond this limit must be purchased from the Sales Offices of H.M. Stationery Office, price 1d. each net (2d. by post), or 9d. net per doz. (11d. by post).

No. 30 Gooseberry Sawfly (*Revised*).
No. 68 Carrot Fly (*Revised*).
No. 275 Stomach Worms in Sheep (*Revised*).
No. 306 Foul Brood (*Revised*).

"Growmore" Bulletins Copies are obtainable at the price mentioned from the Sales Offices of H.M. Stationery Office or through any bookseller.

No. 3 Preserves from the Garden (*Revised*). 4d. net (5d. by post).

"Growmore" Leaflets Single copies of these leaflets may be obtained free on application to the Ministry only (copies are not obtainable from H.M. Stationery Office). The following further issues are now available:

No. 4 Rye as a Grain Crop (*Revised*).
No. 41 When Land needs Lime (*Revised*).
No. 43 Straw for Fodder (*Revised*).
No. 55 Seed Potatoes and the Need for Economy (*Revised*).
No. 81 Good Feed for Pigs and Poultry (*Revised*).
No. 82 A Good Job of Ploughing (*Revised*).

AGRICULTURAL INDEX NUMBER

MONTHLY INDEX NUMBERS OF PRICES OF AGRICULTURAL PRODUCE INCLUDING GOVERNMENT PAYMENTS* (BASE, 1927–29 = 100)

Month	Uncorrected for Seasonal Variation					*Corrected for Seasonal Variation*				
	1939	1941	1942	1943	1944	1939	1941	1942	1943	1944
January ..	95	149	175	181†	189†	*89*	*137*	*161*	*166†*	*171†*
February	94	144	178	179†	187†	*88*	*135*	*167*	*167†*	*172†*
March ..	91	143	176	174†	182†	*91*	*144*	*178*	*173†*	*177†*
April ..	90	138	161	157†		*95*	*145*	*171*	*165†*	
May ..	82	130	154	149†		*91*	*147*	*174*	*167†*	
June ..	80	129	152†	148†		*89*	*145*	*171†*	*165†*	
July ..	85	137	155†	153†		*93*	*148*	*168†*	*165†*	
August ..	86	140	152†	152†		*91*	*148*	*160†*	*160†*	
September	92	139	147†	147†		*93*	*142*	*150†*	*151†*	
October ..	96	154	164†	163†		*92*	*147*	*156†*	*156†*	
November	106	162	174†	173†		*98*	*149*	*161†*	*160†*	
December	113	168	179†	182†		*103*	*152*	*162†*	*165†*	

* Certain indices since January 1939 have been revised owing to the inclusion of subsidy in the cheese index price.

† Provisional.

NOTICES OF BOOKS

Farming To-day. A Series of Agricultural Education and Technical Development Broadcast Talks. Littlebury and Co., Worcester. 1943. 5s.

The informal style of script which the microphone requires makes easy reading. The book comprises seventeen broadcasts given in the 1942 *Farming To-day* series and ranges through the many aspects of agriculture from sugar beet to seed production; from cows and the cropping for milk to late-sown corn and the utilization of straw; and so on. Not the least interesting contribution is that by Mr. Allan Chapman, M.P., Joint Parliamentary Under-Secretary of State for Scotland, on the achievements of Scottish agriculture during the war. The lateness of the season and greater annual rainfall in Scotland create their own problems, and his account, though necessarily short, should be welcome to the English farmer, if only to give him a better idea of what his brother "over the Border" is doing.

The talk by Mr. W. S. Mansfield on pedigree breeding has a renewed interest in view of his more recent sponsoring of broadcast discussions on that subject under the title "Cattle at the Cross Roads".

Dairy Cows and their Management. B. M. Cookson. Faber & Faber. 1944. 5s.

This small book of 72 pages and 24 illustrations is simply and clearly written for the guidance of beginners in cow-keeping and milk production, whether they are the owners of only a few cows or employees who have become responsible for the management of larger herds under war-time conditions. To both classes it can be most helpful.

The author draws on his wide practical experience for useful hints on the selection of a cow, the management of cows and calves at calving, the housing of dairy stock and the production of clean milk. The chapter on feeding wisely begins by emphasizing the need for growing a sufficiency of suitable foods on the farm, but more might have been said on rations for winter use or reference made to other sources of information on that subject. There is also room for greater clarity in the description of the grading-up system in breeding, and it is unfortunate that the chapter on ailments gives so much prominence to proprietary medicines. In spite of these minor defects, the book can be of definite value to many readers.

Food for Thought. Rolls House Publishing Co. 1944. 1s.

Twenty-three well-known authorities in the horticultural world have contributed to make this booklet of the utmost value to that army of allotment-holders and gardeners who are striving magnificently to keep their households supplied with vegetables the greater part of the year and so lessening demand on shops and transport. As the tentacles of the Nazi octopus are severed from their stranglehold on the countries of Europe, we shall need the unremitting efforts of every food producer, no matter how humble, to allow the maximum diversion of foodstuffs to the liberated peoples.

Each of the contributions is very much to the point, and although it is perhaps invidious to select any one for comment, a single remark may, however, be permitted on the subject of composting. Far too much organic waste still finds its way to the bonfire instead of the compost heap. This is a prodigality no land can afford. Mr. Cheveley's question, "Are you compost-minded ?" is decidedly pertinent.

Messrs. Plant Protection Ltd. are to be congratulated upon the presentation of this small publication, and the concurrence of the publishers to pass on to the Red Cross Agriculture Fund all profits from its sales is a fine gesture.

2235 Demand No. 10 Wt. No. 13 6/44 CN&Co. 466

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A SELF-SUPPORTING EAST ANGLIAN DAIRY HERD

A. H. COBBALD

Sudbury, Suffolk

THE conjoint demand for self-sufficiency in feedingstuffs and an increase in the output of winter milk seemed at first to many dairy farmers an almost insuperable problem. Many farmers in the Eastern counties sought the solution by reviving the rapidly declining practice of including a bean crop in their rotation. Beans are our most valuable source of home-grown protein, and in the old four-course rotation they were an excellent preparation for wheat and a good cleaning crop. They are easy to grow in rotation, will withstand severe weather conditions at harvest time and are largely immune from attacks by wireworm, especially when taken as a second straw crop after grass. It was, and still is, considered good husbandry to spread 15 loads of dung per acre on the stubble, and to this, in Suffolk, it was usual to add 3–4 cwt. superphosphate per acre.

Beans for Protein In the opinion of many experienced growers it is preferable to sow the beans with a bean drill when ploughing the land rather than to drill them like corn. This is accomplished by sowing every third furrow with about 3 bus. of seed per acre, which allows thorough inter-row cultivations for cleaning purposes. The number

and type of cultivations are governed by weather conditions and the degree of cleanliness of the land. Sowing is usually carried out about the end of September or the beginning of October, and thereafter the land is harrowed and left in a reasonable tilth—not too fine, since the presence of small clods affords a certain degree of shelter for the young plants during the winter. In the spring, as soon as weather conditions permit, the crop is harrowed, horse-hoed and hand-hoed in the row, and headlands are re-ploughed and cultivated The operations of horse-hoeing and ploughing the headlands are repeated at intervals, as required for cleanliness.

The crop is ready for cutting when the pods start to turn brown, but they may, however, be left in the field whilst other and more sensitive crops are harvested. Before threshing, care must be taken to see that the beans are thoroughly dried out ; if possible they should be left in the stack for at least four months. Partially dry beans threshed for storage will soon become mouldy.

My own farm carries a herd of 40 Red Poll cows and approximately 60 younger female stock. Being self-contained, it has for the most part been self-supporting in feedingstuffs for many years, although the temptation, some years ago, of Russian oats at £4 10s. per ton did not go unheeded ; and the growing of sugar beet has also varied certain practices. Approximately two-thirds of an acre of beans yielding 8 sacks per acre will supply enough protein for an 800-gallon dairy cow, with a margin sufficient for the smaller needs of the younger stock. The requirement of oats for the dairy cows and younger stock is taken as one acre per cow—in my case a total of 40 acres. The beans and oats are mixed in the proportion of one part beans to two parts oats, and these are ground on the farm and fed to the dairy cows at milking time strictly according to yield, at the rate of 4 lb. per gallon of milk over one gallon.

Feeding to Milk Yield Steaming up is also practised and the same concentrates are fed, bearing in mind the prospective yield. Recording and careful rationing are two supremely important factors in the management of a dairy herd, for without them it is impossible to make the most effective use of the rations.

I discovered recently an article written in 1896, urging the benefits of increased milk production to be derived from steamng up cows for six weeks prior to calving. I gather that the practice did not become popular at that time, owing to the lack of knowledge concerning milk fever. With regard to milk fever, I am a firm believer in the value of chalking or liming of pastures ; a great deal of veterinary service for milk fever would, I think, be obviated if this practice were more widely adopted.

Peas instead of Beans this Year We do not take hay from permanent pasture, since there is sufficient for the pasture to do to afford good summer grazing without supplying the winter needs of the herd also. Another factor which influenced this decision was that locally grown legumes crop heavily and are thought to contain natural minerals in a form unequalled by any out of a bag or laboratory. A further reason is that the arable land benefits by rest and change ; if necessary, after hay it is broken up and part-fallowed in preparation for the next crop. During the past few seasons the stocks of beans seem to have deteriorated, and it is interesting to know that trials have been arranged to obtain more information on this point. This year, in view of some disappointment with the bean crop, I am trying a field of maple peas sown with exactly

the same preparation as for a bean crop. The width of the rows is also the same, to allow of similar row crop cultivations. They suffered no damage during the winter and at present give every promise of high yields. I propose to use these peas to replace the beans in the ration for 1945.

Value of Lucerne and Sugar-beet Tops Another practice which has proved of great value is the growing of ½ acre of lucerne per cow—either lucerne with timothy on heavier land, or cocksfoot on lighter soil. It has proved itself to be a great stand-by in a dry season, often providing food when all other forms were in very short supply. If not required for this purpose it makes excellent hay, provided it is cut before it gets too old. I have seen good silage made from it too.

I have little experience of feeding silage to dairy cows, but during the winter of 1937-38 I did out-winter 20 in-calf heifers on sugar-beet top silage and hay, and they did very well. The ensiling was carried out by making a heap similar to a carted-on manure hill and driving the horses and carts over it to obtain consolidation. It was sealed by covering with straw and soil. If I were not a grower of 80–100 acres of sugar beet each season, I would grow kale and mangolds for my dairy herd, but I am able to use pulp instead. I do not feed sugar-beet tops to the dairy herd, as normally they are all required for folding by a flock of pedigree Suffolk ewes.

The Maintenance Ration The maintenance ration of the milking herd in winter is 10 lb. dried sugar-beet pulp and 14 lb. mixture hay. I have found it beneficial to thoroughly soak the dried sugar-beet pulp in approximately 2½ times its own weight of water for 24 hours before feeding, and it is important that no more should be soaked than is likely to be consumed immediately, as it is liable to ferment, with harmful effect on digestion.

The younger stock, except those under one year old, are also maintained on 4–7 lb. of sugar-beet pulp per day, with at least one feed per day of leguminous hay. In an unfavourable season I have had to substitute the hay ration by either barley straw or oat straw, and the animals have come through well. When a sufficient quantity of legumes is not available and straw only is fed, it has been found necessary to add 5 per cent. of minerals to the ration of sugar-beet pulp to avoid the dangers of mineral deficiency. I believe that the scientist will yet discover additional virtues in home-grown foodstuffs for man and beast that are not apparent to-day and which do not exist in the quantities required in some of our imported foodstuffs.

A Good Sire is more than Half the Herd The importance of the herd sire has always been recognized, and it has been said that a good sire is half the herd. He is far more than that—he may be worth his weight in gold ; a bad sire may be an everlasting liability. I think that we have a lot to learn from the Dutch and Americans in regard to bull-breeding and the use of prepotent sires. Personally, I would never buy, or use, a bull unless he were out of a good recorded cow (which, if possible, I should like to inspect) got by a sire with a good recorded dam. The only exception to this rule was a proven sire which I bought for £30. I now have in my herd seven of his daughters (average 8 years old) which last year averaged 11,000 lb. per cow, thereby earning £210 gross more than the daughters of an 800-gallon sire. This multiplied over five years and over 40 cows would come to a lot of money. Another point to which I always pay great attention in a sire is the placing of the rudimentary

teats. This, I feel sure, is an indication of the type of bag and teats bred in the progeny of the bull. I think that a little more attention to this point before licensing would be well repaid. I always like to see the rudimentary teats well forward of the scrotum, spaced well apart and of nice shape, neither too large nor too small.

Proof of Success is Performance It will be realized that my herd is of a dual-purpose breed, and all bull calves unfit for rearing as bulls are steered and sold as fat bullocks. The cows lie in an open strawyard all the winter; I would not sleep them in the cow-shed, as I believe they are much healthier in the open and, being polled, they can be yarded in greater numbers with no damage from horns. During the past 20 years they have averaged between 800 and 900 gallons a year. During 1942-43 the herd average was 940 gallons per cow. In the year preceding the war my herd successfully competed for the first time for a cup open to all breeds and given by Lord Alastair Graham to the Suffolk Milk Recording Society, one of the largest societies in the country, to be awarded to "The herd gaining the most points for Milk Yield, Butterfat and Breeding Regularity". I have had no opportunity of trying to win it again, as it has not been competed for since the war.

I breed pedigree, milk-recorded, attested cattle, not as a hobby but because I must make my farm pay in order to live. My reasons for having pedigree animals are: (1) I want to breed my herd with a policy; (2) I have something with a known ancestry; (3) if I breed an animal of good type I can cash it at from double to even ten times its ordinary commercial value, and it costs no more to rear than a mongrel. Reasons for milk recording have been so well advertised by the Ministry of Agriculture that I need not detail them. My reasons for being attested are: (1) fourpence per gallon T.T. bonus is approximately £500 per annum in my pocket; (2) I do not wish to perpetuate the breeding of tubercular animals; (3) the general level of health is improved; (4) depreciation and replacements are less; (5) the stock are of greater value. Before the war my herd was costed by the Economics Branch of Cambridge University, whose assistance I very much appreciate. I then had cows of three breeds. It was brought home to me very clearly that it is not the amount of milk produced per cow that is the hallmark of success; *it is the cost of production per gallon.*

SUFFOLKS AS GRASSLAND SHEEP

W. B. Johnston

Glamis, Angus

WITH more land going into short leys, there is a revived interest in grassland sheep. This is a brief account of how I run a grass flock of pure-bred Suffolk sheep. Rams go to the ewes on August 6—this date because I breed ram lambs. Later tupping would suit fat or store lamb producers better, since it is after lambing that the ewe consumes most food. In August the ewes are running on leys or hay aftermath and need little attention, except to ensure that they are settling to the ram. For this purpose we colour the rams on the breast with a mixture of red ochre and burnt tractor oil for the first 14 days and then with blue ochre and oil for the next 16 days. In this way the ewes can be marked for the week in

which they will lamb, and any ewe that turns is easily identified by the blue mark. I have always found that after an ineffective service a ewe returns at 17 days, so that the change of colour at 14 days keeps us on the safe side.

Feeding Before Lambing When the grain harvest has been carted the ewes are put on the stubbles to clean up. Undersowing the grain with Italian ryegrass and a small proportion of red clover gives an abundance of sheep feed at this time; it can be fed with fattening lambs—the ewes following up. The breeding flock is then moved on to stubbles and leys until the end of November or the beginning of December, as weather and grazing conditions permit. By then it is within a month of lambing time, and the ewes need a little extra food and attention. The feed available now consists of mangold tops and sugar-beet tops on the ground where grown, the remains of autumn-cut cabbages and yellow turnips. Choosing a ley field which has not been too heavily sheeped, we allow the ewes on the mangold and beet tops for a few hours daily, following up with the cabbage ground and then on to turnips.

Turnip and Kale Growing Some description of my method of growing yellow turnips and kale may be of interest. Labour being scarce and expensive, I tried the following method with success. The land intended for roots or kale was ploughed early, not too deeply where in ley or dunged. In spring the surface was well cultivated, harrowed and rolled and well dressed with turnip manure. The fields were then seeded with 1½ lb. per acre of yellow turnips or 3 lb. per acre of kale. To secure equal sowing we mix the seed with grass or other material that will sow through a machine, or add 1 cwt. Nitro-chalk per acre and broadcast immediately after mixing. Harrowing and rolling again at once completes the job. The soil must be free from weeds, and with this in mind, it is a good plan to have the ground ready for seeding a month in advance. Another harrowing and rolling just before seeding kills all weeds that have started to grow. This procedure can be arranged quite easily, since there is no need for very early sowing—the end of May or the first week in June is early enough.

Feeding After Lambing When lambing begins we bring the ewes into a shelter at night and turn them out to turnips and ley all day. As soon as the lambs are strong enough to follow their mothers, they are put on to another field—young grass if possible, with a run on to thousand-head kale daily. At this stage the ewes receive a little concentrated food if available, along with good hay which makes up for shortage of feedingstuffs. We use bruised oat and wheat tailings, beet pulp and anything else that is available. A few protein coupons which have been issued for breeding ewes are reserved to start the lambs on their way. When they start feeding we fence off a good piece of kale into which they creep through a hurdle made of upright bars, so spaced as to keep out the ewes. Here they have their mothers' protein coupons in the form of linseed cake, with some of the ewes' mixture added. This treatment continues until the kale is eaten off and grass is solely supporting the flock.

This winter treatment may appear somewhat similar to folding practice, but it is designed to save as much labour as possible in pulling and carting roots, and also to keep the leys clean. It is seldom that we close fold, and the big breaks are fenced with wire-netting or electric fencing. Later

lambing would, of course, dispense with a great deal of the roots, kale, hay and concentrates which are needed in early lambing. Starting to lamb a month before grass can be expected to support the flock fully would be the ideal time for a commercial flock.

Weaning The lamb crop in our pure Suffolk flock averages around 160–170 per cent., which I consider to be high enough, since with a further rise in the birth-rate, there tends to be a too large proportion of small lambs. With our early lambs, weaning takes place at the end of May. This is a very important time, for it is then that we cull the draft ewes. If they are fat (and they are generally) they are graded along with the worst ram and ewe lambs that are of no use for breeding purposes. Grading at this time is the only advantage of early lambing, as mutton prices are at their highest. The ewes and gimmers that are to be kept for next year's lamb crop are now clipped and their feet pared. They are dosed for worms and then put on to a heather hill, where they remain until they are brought down to be put to the ram. Bringing them down a fortnight before putting the ram out helps to give a quicker lambing and a bigger crop.

The ewe lambs that have been selected for future stock purposes are run on grass with no extra feeding right on through summer and autumn. They are again dosed at monthly intervals to keep them free from worms. Then, when grass is scarce, they are provided with roots, hay and a little oat tailings to tide them through the worst of the winter and to keep them growing, for it is at this age that the foundation of the future ewe is laid. They join the ewe flock, as I have already mentioned, in May. Ewes, ewe lambs and wethers that are not fit to grade at weaning time are subsequently run on good grass, without concentrates, and graded as they are ready. Ram lambs are put on the best grass with a little feeding, then on clover aftermath which brings them ready for sale in September.

My own flock is run as a pedigree farm breeding flock. For commercial purposes, later lambing would be the most economic way to run a grass flock.

The wool clip in this flock averages about 7 lb. per ewe and 8 lb. per ewe hogget, machine clipped—slightly less when clipped by hand.

A Good Ram A grass flock can be either pure or cross bred, but with cross breeding a few of the foundation ewes will have to be bought from time to time to keep up the stock of cross-bred ewes. With my own particular breed, the Suffolk, the type of ram I would advise for either pure or cross breeding would be a sheep with a good, straight, well-covered back, well-filled gigots, a wide and well-sprung body and set on short legs of strong, flat bone. The neck should be thick and not too long, the head strong and covered with glossy black hair, ears thin, fairly long and slightly drooping. The body should be well covered with a fleece that fills the hand and is not too short. If the wool is short and the underline bare, the lambs are inclined to be too short of wool at birth to withstand the weather. In buying a ram, animals showing bareness, narrow shoulders and narrow body, or long legs and thin necks should be shunned like the plague. In conclusion, I would stress three essentials for the success of grassland sheep: light stocking, the shortest possible leys, and adequate supplies of lime and phosphate in the soil.

GROWING PEDIGREE COCKSFOOT FOR SEED

J. E. Pheysey

Stourbridge, Worcs

COCKSFOOT has not always been looked upon with favour by the average farmer, and even now it is not fully appreciated, except by those who have had experience with the newer varieties which have been bred and developed by the Welsh Plant Breeding Station at Aberystwyth. The older commercial types produced an early growth of leaf, but unless well grazed tended to deteriorate into tussocks unpalatable to stock.

Certain indigenous types of cocksfoot, together with various imported varieties, have been developed by the Welsh Plant Breeding Station, and improved, so that there is now a whole series of distinct strains of valuable grasses, etc., each labelled with the prefex "S". Thus there is a hay-type strain known as S.37—which is the variety I am growing. It is an early starter, has more leaf than the Danish and gives a good bite when most needed.

All the cocksfoot strains are deep rooting and are, therefore, especially suitable for the lighter types of soils, and some strains stand well at the higher elevations.

The growing of grasses has developed rapidly since the war, and while there is nothing difficult in growing grass for seed, we are still in the process of improving our methods, and there are many unexpected obstacles in seed production, as with most new crops, which may trip up the inexperienced.

Siting and Sowing Isolation is the first essential in the cultivation of pedigree strains of cocksfoot for seed. No other strain or variety of the same species should be grown on the farm if the possibility of crossing or admixture, and consequent adulteration, is to be avoided, and the field itself must be completely isolated at a distance of at least 200 yd. from any pasture. If that minimum distance should be impossible, then all the pasture grasses must be kept from flowering by means of hard grazing and the mower.

Having selected a good, isolated site, the next essentials are that the field should be in good heart and free from such weeds as twitch and thistles. A reasonable number of small annual weeds can be dealt with by inter-row cultivations, although in the seedling year they may prove a nuisance and necessitate either spraying or hand-hoeing.

A hay type of cocksfoot may be sown either alone or mixed with some other seed, such as S.100 white clover. It may be broadcast with or without a nurse crop, but for intensified seed production there is little doubt that the best method is to drill in rows 24 in. apart, without a cover crop. To permit of early horse-hoeing it is desirable to adopt some method whereby the drills may easily be seen. One method is to mix in a little white mustard seed or some other quick-growing plant to show up the drills. On my farm we use the beet drill, which drops the seed on the surface of the soil; the curved blades mould up sufficient earth to cover the seed and form a small ridge, thus giving a clear indication of the run of the drill. After drilling, the ridges are rolled with a flat roll.

An important point in drilling is to allow a wide headland. At harvest time it will be found useful to run the empty binder along the headland rather than bump over the rows of cocksfoot; also it allows space for a row of stooks clear of the binder.

May I here appeal to farmers to use horses for light jobs such as seed drilling? All too often one sees tractors being used for work which could be done easily and more economically by horses. Two photographs which I saw reproduced in a farming periodical recently illustrated this well: one showed a tractor drawing a four-coulter drill sowing timothy on the flat—a job which can be done easily with one horse; the other showed a manure distributor drawn by a tractor along potato ridges—another undesirable and uneconomic job. Every drop of T.V.O. or petrol has to be imported at the risk of men's lives, and at the same time there is an urgent demand on our shipping for other needs.

Estimating the Seeding Rate The approximate rate of seeding can be estimated before the drill is taken out to the field. Jack up the road wheel clear of the ground, then put some seed in the drill; making sure that the cups are full and in good working order, place a clean sheet on the ground under the coulter feed pipes. Revolve the road wheel at its normal speed of travel for the number of revolutions required to drill, say, one-tenth of an acre. Weigh carefully the seed dropped on the sheet, and from this calculate the rate of seeding per acre.

The formula for obtaining the number of revolutions of the road wheel to drill one-tenth of an acre is as follows:

$$\frac{484 \times 9}{\text{Sowing width of drill (ft.)} \times \text{Circumference of wheel (ft.)}}$$

In my own case, the sowing width of drill = 7 ft. 4 in. = 7.3 ft. and the circumference of wheel = 13 ft.

$$\text{Thus:} \quad \frac{484 \times 9}{7.3 \times 13} = 46 \text{ revolutions for one-tenth acre}$$

The normal rate of seeding advised is 4–6 lb. per acre. Two years ago we used 3⅔ lb. per acre and obtained a really thick crop. This year we have used under 2¾ lb. and await results.

Previously the sowing width has been 24 in., but this year we are trying out at 21½ in. for the following reasons: (1) four drills at 21½ in. just fit in the drill width; (2) four rows instead of three are drilled at one time; (3) the Aberystwyth strain which we are using (S.37) is a hay-type grass, and does not grow so thickly as the more spreading S.143 (it is hoped that the reduced width will not materially restrict inter-row cultivations); (4) 21½ in. is the same width as our beet drills, so that row-crop implements can be interchanged without alterations.

Land must be Kept Clean It is very necessary to keep plants clean in the seedling stage, and hand-hoeing may have to be carried out after horse-hoeing between the rows. The horse-hoe should be used as often as required, but should not be attempted too close to the young plants; otherwise they may be lifted or their rootlets broken. When the plant is established, potato scuffles are used, and deep cultivations given in the autumn. Deep and thorough cultivation after harvest is held to be essential for good seed production.

Grazing with Cattle in the Autumn Grazing can be carried out, but it needs very careful supervision. Within certain limits a cocksfoot seed stand will provide a considerable amount of feed for stock, preferably cattle—not sheep. The important thing to watch, in autumn, is that the animal does not bite into the cocksfoot so hard that the embryo seed-producing shoot is damaged. The

shoot producing the seed next year is formed in the autumn and comes up through its sheath the following spring. It follows, therefore, that if seed is the aim, there can be no spring grazing.

My method was to turn in the cattle, after the morning's supply of beet tops has been eaten elsewhere, to leave them on the cocksfoot until they have had their fill and then remove them for the night. In this way I have grazed cattle up to and beyond Christmas, but always, of course, keeping a careful watch that they do not graze down to the seed shoots.

In late March, a top dressing of 1½ cwt. sulphate of ammonia was given, the rate of application being increased as needed in subsequent years. Inter-row scuffling to break up the winter crust is given in spring, but it should be less deep than that done in the autumn, because of risk of damage to the side roots, and should be completed, if possible, by the end of March.

Careful Harvesting to Prevent Loss of Seed

Harvesting time should be watched for carefully and an average struck as to ripeness, so that the maximum of seed is stooked. Remember that once the plant is dead ripe the seed sheds very easily. It is not unusual to cut cocksfoot in the early morning and again in the evening after sundown, thus avoiding the heat of the day, when loss of seed is considerable. On my farm we use a power-driven binder.

It is well worth while spending a few hours on the binder, fixing gadgets to save seed at the points where losses occur. We tackled the problem as follows. Seed shed on the platform canvas is automatically thrown on to a large tin tray fixed between the big wheel and the platform canvas frame. At the gap between the top of the elevator canvas and the binder platform, we fixed a canvas trough. At the bottom of the binder platform a weed seed catcher was fastened with a tin chute to guide the seed knocked out by the packers into the pocket of the seed catcher. The seed from the "savers" was emptied into sacks as required, and well repaid the little extra time and trouble.

In binding a thick crop, it is often an advantage to have someone following the binder to clear the dividing board and assist the grass across the platform canvas. The heads of the cocksfoot become tangled and the sheaves do not part readily, so that it also helps to have a girl clearing the sheaves from the binder platform. The sheaves should be tied as small as the binder adjustment will allow.

Stooking is done by setting up four sheaves in the form of a cross. A girl, equipped with a bunch of strings in her belt, follows the stooker and ties the stook firmly around the head above the bands to prevent it being blown down. Every time a stook is handled seed is lost. When the time comes to carry, the whole stook is forked smoothly on to the wagon.

Every means of saving seed should be adopted. Some growers dislike a loader on the wagon because of treading out the seed, but in my view once the seed is on the wagon it can be saved. Unless the wagon has a sound bed, sheets or bags should be laid down. Similarly, sacks should be draped or tied over the ladders or thripples and each wagon should be cleaned of loose seed after unloading.

Sheets are also spread to catch seed shed between the wagon and the rick. In this way several hundredweights of seed can be saved.

Threshing Hints Threshing problems appear to be solved in various ways according to the district. An ordinary threshing box fitted with the necessary riddles, etc., can thresh all grasses, except timothy, satisfactorily. The first necessity is a modified caving riddle. It should preferably be made of wood, with the first two steps blanked off or smooth; the next 1-ft. length should be drilled with ½-in. holes and the following 1-ft. length drilled with ⅜-in. holes. To prevent their becoming choked these holes should be tapered, so that they are slightly larger below. If the holes are finished off by passing a hot iron through them, any roughness of the wood will be eliminated. It is a big advantage to have the riddle fluted at right angles to the line of travel and the holes lying in the bottom of the flute. The remainder of the caving riddle is blank, for it is generally found that 2 ft. of riddle space is adequate and also prevents too much cavings passing through with the seed. Riddle sizes vary, but personally I have found the following satisfactory: bottom shoe top sieve—5 mm.; bottom sieve—0.5 mm. (or if preferred, blank); second dresser top sieve—3 mm.; bottom sieve—2.5 mm.

Having first opened the rotary screen fully and removed all obstructions from between the wires, it should be closed well up. The first and second grades will then come through the wires, while bits of straw, etc., will come over the end of the screen.

The concave should have a metal plate (or a packing of straw will do as a makeshift) fixed behind the upper third, to prevent the seed heads from escaping through the concave before being properly threshed out. The concave needs adjusting according to the condition of the crop, and the weather at the time of threshing, but the following gap measurements may serve as a guide: top 1½ in.; centre ¾ in.; bottom ⅜ in. Do not set the concave so close that the seed is hulled or skinned.

We find output better if the drum speed is a little below the normal for cereals.

Adjusting Wind Force in the Blowers The volume and force of the wind used in the blowers is extremely important, for obviously the same force of wind as is used for grain would be much too strong for grass seed. Actually, it is usually better to maintain the volume of air, but to reduce its force. This is done by increasing the size of the fan pulley and reducing the air intake as needed.

A local carpenter turned for me a wooden pulley to size, which was sawn in half, and bolted on the fan spindle—a simple job and one that answers the purpose very well. As there was sufficient clearance, I had three sizes of pulley turned on the same piece of wood, thus giving three different fan speeds to meet different conditions. The size of pulley most frequently used on the big fan is of 10-in. diameter (from 6¾ in. on grain); the second dresser pulley most commonly used is 8 in., while the original grain size was 4 in.

The bolts through the pulley are slackened and the pulley moved along the spindle to line up the size needed, and reclamped. Naturally belts have to be adjusted to suit the diameter of the pulley. When dealing with light material like grass seed the blower needs constant watching, because the setting depends on the wind and weather on the day.

The output with my 40-years-old box is around 1 cwt. per hour, and with the few alterations mentioned it does a creditable job of threshing. Gross returns were 1,188 lb. per acre (866 lb. net).

In conclusion, I should like to pay tribute to the work of my W.L.A. staff. These girls have done most of the work, including cultivating, horse-hoeing, stooking and harvesting, and with slight supervision and assistance, all the threshing of my pedigree grasses. Without their interest and assistance, such excellent results would not have been achieved.

LUCERNE FOR THE NEW GROWER

I. V. Hunt, M.Sc.

Chester

CONSIDERABLE acreages of lucerne are cultivated in the south-eastern counties of England, small areas in the south-western and north-eastern counties, and at present only a few plots on an experimental scale in north and north-western England and the Midlands, and in Wales and Scotland. It is probable, however, that much more could be grown with advantage. The crop has often been tried by farmers, but where no advice is sought or given, failure is almost certain to result. Although there are other ways of growing lucerne, it is suggested that the method outlined in this short article is the most likely to give a long stand at the first attempt.

Choice of Field The first essential is that the field must be *clean*, well drained and in good heart, preferably dunged in the autumn or for the previous crop. An ideal choice for a beginner intending to sow without a cover crop would be a portion, say 2–3 acres, of the current year's root field, root crop preparations having been given to the entire field. If cuts are required for soiling or feeding green, the field should be conveniently accessible. If summer sowing is to be attempted, a field from which early potatoes have been lifted would be ideal. Lucerne will act as a fertility ley on an unfenced, unwatered field, as it will not commonly be grazed.

Manuring An effort should be made to apply all the fertilizer which the crop is likely to require before sowing is begun ; in point of fact, since the roots of lucerne go down deeply into the soil, top dressings to the growing crop are of very little use. Generous applications of dung, and lime, where needed, should, therefore, be given to the preceding crop as part of the initial preparation of the soil. In addition, the crop requires phosphate. Under present conditions a dressing of approximately 3 cwt superphosphate, or its equivalent in other phosphatic fertilizer, is allowed.

The first thing is to get the soil tested, and for this purpose the Agricultural Organizer or the County War Agricultural Executive Committee should be consulted. Even if according to the analyst's report the soil is not lacking in lime, it is advisable to apply 2 tons of chalk or ground

limestone to the soil in the autumn, winter or early spring. If autumn chalking is impossible, apply 10–15 cwt. of burnt lime per acre just before sowing and work into the soil whilst preparing a tilth with harrows.

Lucerne is not a crop which one would generally expect to respond to applications of dung: its need for it is related to the organic and carbohydrate requirements of the bacteria. Dressings should be the same as for root crops, applied in the previous autumn and ploughed well in.

Seed Inoculation It is not necessary to apply any nitrogenous fertilizer to lucerne, since, like all other legumes (clovers, peas, beans, etc.), it prefers to obtain its nitrogen from the air. Examination of the roots of a healthy lucerne plant should show white or pinkish galls, known as root nodules. Each nodule contains countless numbers of bacteria (*pseudomonas radicicola*), all of which absorb nitrogen from the air in the soil. Normally the lucerne obtains its nitrogen from compounds secreted by these bacteria. In this way lucerne is independent of nitrogenous fertilizers. When ploughed up the nitrogen accumulated in the root residues is released to add fertility to the soil. These bacteria, so essential to the growth of lucerne and related crops, are present only in those soils where the crop has been grown previously. Moreover, each legume requires its own strain of bacteria; that inhabiting the root nodules of red clover, for example, is of no use to lucerne.

The right kind of bacteria will be present wherever lucerne has previously been grown satisfactorily, but it is generally best to assume that they are absent from the soil and to have the seed inoculated. Some farmers tend to shy at this practice and consider it extremely difficult, but the instructions sent out with the tubes of bacteria are quite clear. All that is required is to bring each seed into contact with the bacteria. Most people are aware of the sensitivity of bacteria to sunlight; these bacteria are no exception, and every effort must therefore be made to keep the cultures and the dressed seed out of bright light.

The process is simple and inexpensive—about 3s. per acre—and the preparation can be obtained from Allen and Hanburys, Ltd., Bethnal Green, London, E.2., with full instructions. The seed should be sown as soon as it is dry. Generally inoculation should be carried out the day before sowing. It has been shown that a better crop establishment is obtained by inoculation, even where lucerne has previously been grown successfully.

Sowing A fine tilth, similar to that for roots, should be prepared. The best results are obtained by drilling a mixture of 20 lb. lucerne and 5 lb. cocksfoot during April without a cover crop. A corn drill can be used for this purpose. On clean land equally good results are obtainable by broadcasting the seed with a fiddle or seed-barrow. One point in favour of drilling is that inoculated seed is not exposed to direct sunlight. Where a seed barrow is used, a harrow should follow immediately behind.

First Year Cuts It is most important not to cut the lucerne until the secondary buds have started to develop at the crown —usually after 8–10 weeks, when the first shoots are some 6–8 in. high. Growth made from September onwards should be let stand through the winter.

Second Year Cuts In the second year, hay or silage can be made in the first week in June, and two further cuts taken later during the year. At the end of the second year, if the ley is becoming dirty, the crop will benefit from harowing with a spike harrow. If this does not tear out all the weed grasses, more drastic treatment with a cultivator can be undertaken. But such cultivations must be done in the autumn and on no account in the spring.

Well-managed, a lucerne ley of this kind will last for six years or more, but it is advisable to plough it up for some other crop at the end of the fifth or sixth year. Hay or silage can be made of all cuts, or the crop can be fed green: most stock take to it readily. The crop can also be grazed, but it is advisable to eat it off quickly and then rest the field for a spell. Similarly, grazing should not be too severe; moreover, the crop should not be cut or grazed after the end of September, since it is advisable to leave 4–6 in. of growth to act as a cover for the sensitive buds during the winter.

Varieties Several varieties of lucerne were available in peace time, of which Provence used to be the most popular, but Canadian Grimm is probably the best variety available now, and is more hardy than Provence. The Welsh Plant Breeding Station have their own newly developed strains under test. Many extremely good varieties are available in America, including one creeping variety which promises well for pasture establishment under conditions of extreme drought.

Lucerne Mixtures Lucerne gives very heavy crops when sown alone, but still heavier crops, easier to make into hay, when cocksfoot is added. Generally too much cocksfoot is used, and experience in Sussex has shown 4–5 lb. to be the optimum. Timothy and meadow fescue can be used in the same way.

Suggestions for Lucerne Mixtures

	(1)	(2)	(3) *lb. per acre*	(4)	(5)
Lucerne	24	20	20	12	16
Cocksfoot	—	5	—	4	—
Timothy or meadow fescue	—	—	6	4	—
Italian ryegrass	—	—	—	—	½
Late-flowering red clover	—	—	—	2	—
Alsike	—	—	—	1	—
New Zealand white clover	—	—	—	½	—
Wild white clover	—	—	—	—	¼
Unmilled common sainfoin	—	—	—	—	56
TOTAL	24	25	26	23½	72¾

The fifth mixture is that recommended by Mr. Wm. Alexander of Eynsford, Kent, for use on chalky banks.

FLAX PRODUCTION IN WAR

THE RIGHT HON. THE EARL DE LA WARR, P.C.
Director, Home Flax Production

(*Reproduced by kind permission of the Royal Society of Arts from the paper read to the Society on May 24, 1944*)

FLAX is the raw material of linen. It is probably the oldest vegetable textile in the world. Its origin has been lost in antiquity, but we hear of it first being produced in Egypt—over 6,000 years ago. Although the decorticating, spinning and weaving machinery were of the most primitive kind, a careful examination of cloth still extant shows that the yarn was spun to a degree of fineness that cannot be equalled by modern machinery.

Flax is also the only vegetable fibre referred to in the Bible. Wool and silk were, of course, known, but for general purposes linen was the staple material used for clothing the biblical ancients, particularly the upper classes. Even the priestly garments, the aphods, were manufactured from the finest linen.

History of Flax-growing in the United Kingdom

The cultivation of flax in Europe was introduced from Egypt. Greeks and Romans used it extensively both for under and outer garments—and it is probable that their conquests were responsible for the gradual spread of its cultivation in Europe. It was late in arrival in this country, and it is not until after many centuries that we find it growing here. But up to the beginning of the nineteenth century it was still so essential for the sails of the Navy that a certain proportionate acreage was sown compulsorily on every farm. The sails of the "Victory" were grown in this country and spun by a Scottish gin still in existence: in certain areas of Scotland the marriage portion and trousseau of the farmer's daughter were partly of linen produced on the family farm. In 1864, 315,000 acres (about double the present acreage) were grown in the United Kingdom.

The other day, looking through a book on Scottish agriculture written in 1800, I found a chapter on the growing of flax. Its injunctions were so sound and so in accordance with what we have learnt by painful experience during the last four years that I have sent a copy to every one of our factories.

The amount of labour that was needed—cheap but highly skilled hand labour—drove it out of cultivation in this country towards the end of the nineteenth century as our standard of living began to rise. Belfast and Dundee kept alive the spinning and weaving of the fibre, but gradually we left the growing of it to other countries. This process of decline was slower and less complete in Ireland than in Great Britain, but the tendency was the same.

During the Great War of 1914-18 we attempted to grow flax, but without success. Between the wars its cultivation dropped as low as one experimental plot of three acres at Sandringham in 1931. Only to-day, when we have begun to achieve a certain degree of success in mechanization, has it become possible to re-establish the industry in this country.

Heavy Fibrous Crop Required

Whether mechanized or not, the problem is, of course, the same. Flax is an agricultural crop producing on an average about 2 tons of straw to the acre. This should yield approximately 4 cwt. of long fibre, with something less than 4 cwt. of tow or short fibre and 4 cwt. of seed as the

most important by-products. The inside of the straw is wood and the outside is fibre to the extent of anything between 20 per cent. and 30 per cent. of the total weight. The main problems, therefore, are first how to grow a crop with a heavy fibre content, and second, to extract that fibre in a form acceptable to the spinners. Those who know the industry well would say that the quality of the crop is over 75 per cent. of the whole problem of the industry. Our experience would certainly confirm such a statement. No factory, however efficient, can extract fibre that is not there. In one day I have myself seen two different crops going over the same scutching machine—the first yielding 1½ per cent. and the other 12 per cent. of long fibre. On the other hand, great skill is needed for separating the wood from the fibre and in making the most of such fibre content as there is.

Flax is in many ways a peculiar substance, not least is the extraordinary fascination which it exercises over those who have to deal with it. The report of the Select Committee on Home Flax Production prefaced its comments by stating that all the expert witnesses appeared to disagree. It was a fair point for them to make. Farmers disagree as to how to grow it and as to what land is best; processing factories on how to handle it; whilst no two spinners would agree on how to grade a particular parcel. Here perhaps we see one of the main reasons for its fascination, which explains incidentally—at least in part—why the spinners of Belfast and Dundee remain amongst the most individualistic enterprises in the country. A substance that is so difficult to standardize is a bad subject for rationalization, and like the production of wine presents problems of subtlety and variation, the apparent infinity of which must attract the inquiring, the adventurous and, above all, the individualistic mind.

Is it to be wondered at, then, that the courage with which we in this country have increased its production in the space of three years from a few hundred to over 60,000 acres met with initial difficulties that at one time seemed almost insuperable—all the more so in that the recognized methods of countries with previous experience of growing and processing of flax for centuries were denied to us? They were denied to us because they demand quantities of labour that are out of the question for us in war time—and highly skilled labour at that.

The Labour Problem Thus flax is normally pulled by hand—a skilled man can pull just over one acre per week if the crop is not laid—which it frequently is! With 60,000 acres this would mean a minimum labour force of 10,000 skilled men for six weeks. In practice, as experience has taught us, with unskilled labour the figure would be nearer 20,000, or even 30,000. Although, therefore, machine pulling was in its infancy, there was no alternative to concentrating on machine rather than hand pulling.

Again, flax is normally retted, that is, soaked in water for some days until the gums that fix the fibre to the wood of the straw are broken down by bacterial action. This process also demands both skill and numbers that were not available to us in this country; skill especially is needed. Indeed, an attempt to ret at short notice on a large scale was made during the last war, and this was probably the major reason for the virtual failure of the scheme at that time.

Twice the quantity of labour would have been needed. Nor was it necessary to ret from the point of view of the war. Green flax was able to satisfy Service Departments for many war-time purposes, such as

parachute harness and naval canvases, whilst retted fibre, when the decision was taken, was still obtainable from the Low Countries. Later, when that source dried up, the acreage was expanded in Ireland, where they knew how to ret. Last, but not least, as the Irish system of retting destroyed their seed, their expansion was possible only if we pursued a policy that enabled us to save seed for their sowing as well as our own. The production of green flax and seed in Great Britain and of retted flax in Ireland were, therefore, two sides of a carefully thought-out scheme. It is, of course, generally admitted that for most peace-time purposes retted fibre is preferable to green fibre, and that this virtually new product has called for a good deal of adaptability from the spinners—an adaptability that for various reasons has been easier to apply in Belfast than in Dundee.

Finally, until very lately flax has always been hand scutched on what were called "handles"—actually bladed wooden propellers of about 3 ft. radius. Scutching means the separation of the woody part of the stem, which forms the inside of the straw, from the fibre that encloses it. Each handle or set of blades used for this purpose was controlled by one man. This process calls for a great deal of labour and a long period of training. It was, therefore, out of the question for us. Fortunately between the two wars work had been done on developing large automatic scutching machines, and sufficient of these had been tried out in practice for us to choose the best type and adapt it to our particular purpose of scutching green flax.

Need, the Spur to our Effort Thus we have a picture of an industry, which since the days of the Pharoahs in Egypt had been run as little more than a peasant handicraft, dealing with a product that has resisted all attempts at standardization, having suddenly to be built up in this country on a mechanized basis and at a rate that if the compulsion of war had not been driving us would have been sheer madness; most of it, moreover, with both labour and management that had first to be told what flax was.

All this had to be done because supplies first from the Baltic and then from the Low Countries were no longer available—supplies of a substance that has proved to be quite irreplaceable for certain essential war purposes. Its peace-time uses for personal and household linen, for the finer fabrics and for civilian canvases could be reduced or even dispensed with. Wherever possible, cotton has been substituted, even to the extent of using it for railway wagon covers, whose life, as a result, can now be measured in months instead of, as before, in the same number of years. But for aeroplane wing fabric, parachute harness, hose pipe, naval and mercantile marine canvases and linen thread for service and agricultural boots, there is no other textile that will do the job. Thus in 1939 it was decided to sow 18,000 acres in Great Britain, and in 1940, when Belgium was overrun, the acreage was expanded to 40,000. In Northern Ireland the peace-time acreage of just over 20,000 acres was expanded to 100,000. These expansions were the maximum for which there was seed in this country.

Teething Troubles How far have we succeeded in our efforts? I assert that they have succeeded to a very remarkable degree. 1940 and 1941 gave us the inevitable crop of teething troubles. The farmers overworked, knowing nothing of what land to choose, and having no experience of either growing or harvesting, the crop produced bad straw yielding little or no fibre. The pulling machines that the factories provided for harvesting the crop were unreliable. To add

insult to injury the harvest weather in 1941 was one of the worst on record. As a result some of the straw was too bad even to attempt to process, whilst that which did come into the factories gave a miserable yield of fibre. In the factories themselves the labour and management were unskilled, the machinery continually broke down, and the already poor raw material was made worse by unskilled handling. If a balance sheet of the scheme had been drawn up at that stage it would have been difficult not to have pronounced it a failure, and an expensive failure at that. From the whole of the 1940 and 1941 crops just over 2,000 tons of long fibre of poor average quality were produced, against estimates of over 10,000.

The Turn of the Tide The year 1942 saw the turn of the tide. Had it not been for the fact that, thanks a great deal to the keenness of the late King George V, flax had continued to be grown at Sandringham between the two wars, and that a great deal of experimental work had been done at the Norfolk Research Station before this war, our two years' teething troubles would have extended themselves to four or five years. If, on the other hand, a skeleton industry had been kept in existence all the time, they might have been virtually eliminated. The crop, grown on better land and with greater care, was better in every way. During the winter of 1941–42 we had conducted an agricultural campaign. The Ministry of Agriculture and its War Committees became interested and helpful. Literature explaining the main needs of the crop was distributed amongst the farmers. Meetings were held at the factories, and farmers were shown the difference between good and bad straw going over the machine. Moreover, by now they had gained experience of their own how to grow it, and many had become interested, and even enthusiastic, in the possibility of helping to build a permanent new industry in the country. The machinery, both harvesting and factory, was running itself in and was better understood and maintained. Labour and management were beginning to learn their jobs. As a result production from the 1942 crop was nearly double the combined production of 1940 and 1941. It was also better quality. As far as we can judge, production from the 1943 crop looks like being twice as good as the year before.

In the meanwhile, four-fifths of the factories have been equipped with tanks for retting a small proportion of their crop. In this way we are gradually building up a fund of knowledge and experience.

Continued Progress Research has revealed a method of aerating the water so that it can be used many times over, and this has virtually eliminated the problem of effluent. In the past, retting in tanks has entailed emptying the tanks every ret; that is, discharging every three or four days from a battery of four tanks upwards of 60,000 gallons of an abnoxious effluent ten times the strength of sewage —an operation hardly likely to appeal very strongly to our health or water authorities.

Considerable advance has been made in the artificial drying of flax after retting. Up to the present, retting can be carried out only during the months when flax can be dried in the field. This means that the tanks are used only for four or five months of the year. It means also large seasonal demands for labour. Artificial drying would employ labour for the whole year and would, therefore, double the throughput of the tanks. The technical problem of how best to dry was virtually solved twelve months ago. It remained for us to reduce the capital cost of a drier to an

economic figure. A new form of direct heat drier burning only the waste products of the factory is now being erected for one-half of the cost of any previous drier. We have solved the problem of conditioning the straw to the right degree of moisture, which is necessary if the optimum amount of fibre is to be extracted during dry weather. During the last twenty years new strains of flax have been and are being bred both for fibre content and disease resistance. Further improvements in the machinery, both for pulling and in the factories, are being brought about. Shortage of labour has driven us to yet further mechanization of the whole process. In the long run this may perhaps be all to the good, but at the moment it is preventing us from handling the straw as it should be handled. Finally, our research station in Norfolk is now at work on a machine which on preliminary tests shows promise of revolutionizing the industry by nearly doubling the yield of long fibre. Progress during the last two years has been such that production has increased about five times over, and costs have been halved, whilst almost every day further improvements are being made.

LIFE HISTORY OF THE WILD ONION AND ITS BEARING ON CONTROL

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THE Wild Onion (*Allium vineale.* L.) has long been recognized as a serious weed on agricultural land in certain parts of this country, and several attempts have been made since the beginning of the century to solve the problem of its control. The present contribution is the outcome of a botanical investigation, under the auspicies of the Agricultural Research Council, of the essential features of the nature and behaviour of the plant itself, from the basis of which knowledge the problem of its economic control has been approached. The observations here recorded have all been made in the neighbourhood of Cambridge, where the plant is very troublesome on the gault and heavy boulder clay soils, and it must be pointed out that its seasonal behaviour may not exactly correspond with that found in other localities, so that the treatment here suggested may have to be modified in accordance with seasonal variations in other areas.

A Complex Life Story To understand the complex life history of this plant, it is best to consider first the mature plant as it occurs in July and August (Fig. 1), when the vegetative parts have died away and there remains above ground an erect stalk crowned by a dense cluster of small ovoid bodies, the bulbils. The foot of the stalk, not far below the soil surface, is surrounded by withered leaf bases enclosing three or four lateral offset bulbs (Fig. 2). The innermost of these, which we may call the "major" offset, is generally larger than the other "minor" offsets,* and is different in shape and colour. These, together with the aerial bulbils, comprise the reproductive elements of

* These two types correspond to the soft and hard shelled bulbs respectively of Tinney (see *References 1*).

the plant; the production of true seed is absent or unimportant. Each of the three types of bulb (Fig. 3–6) contains a single fleshy scale invested in a paper-like covering, which, however, differs with each type. It is very thin in the bulbil, and at maturity readily flakes away from the underlying tissue. In the major offset it is considerably thicker; it is tough, light buff in colour, with a glossy surface, and is frequently split when the bulb is fully grown. In the minor offset the outer scale is somewhat darker; it is considerably stronger than that of the major bulb and remains intact at maturity in most instances. At the base of the bulb it is often extended into a short curved stalk (Fig. 4).

Mature plants, such as those described, often constitute from 20–30 per cent. of the total onion population in an infested area, but may be entirely absent, as in pasture land where grazing prevents the production of an aerial head. Other plants at the same season exist in a quiescent state below ground as "terminal" bulbs of varying sizes, so called because the bulb is not a lateral offset but the terminal bud of a plant which has produced no aerial stalk in the preceding season. The terminal bulb resembles the major offset, but is more symmetrical in shape; it may have one or two minor offsets adhering to it, the whole being surrounded by dead leaf bases (Fig. 7).

The bulbs sprout mainly in the autumn, although there is considerable variation in this respect among the different types. Major offsets and terminal bulbs usually sprout between September and November; the bulbils, which are nearly 100 per cent. viable, and have usually fallen from the head by the end of August, rarely sprout before November, and may not do so before the spring. The minor offsets, except for large specimens and others where the outer scale is ruptured, which behave in the same way as the major bulbs, exhibit a marked dormancy, germinating at the earliest towards the end of August, in the year following their formation—rather earlier than any of the current season's bulbs. Large numbers, however, are dormant for at least two years, and Tinney[1] deduces from his experience that the maximum period of dormancy is about six years.

Production of Aerial Stalk or Terminal Bulb

The young plants grow slowly until about the end of February, when they are about 5–10 in. high and bear two or three tubular green leaves. These are produced in succession at the expense of the food stored in the fleshy scale of the parent bulb, which shrivels and usually appears completely exhausted by the latter part of February. Owing to the range of size among the bulbs, accompanied by differences in the time taken to exhaust this food reserve, and also to the prolonged period of sprouting, the date at which this stage is reached varies from plant to plant. Once reached, it is followed by a period of very rapid development, which may culminate in either the production of an aerial stalk or a terminal bulb. The latter course is followed by all plants developing from bulbils, and, on the whole, by those from small bulbs of the other types, but there is no exact correlation with bulb size, and the other factors determining the line of development remain unknown.

When a terminal bulb is to be produced, it has usually been initiated by the end of February, and often earlier. Its origin is the same as that of the previously formed foliage leaves, but no blade is produced and its formation prevents any further production of green leaves until the following autumn, when this newly formed bulb itself sprouts. In all plants the foliage leaves die back from the tip in succession and where a terminal

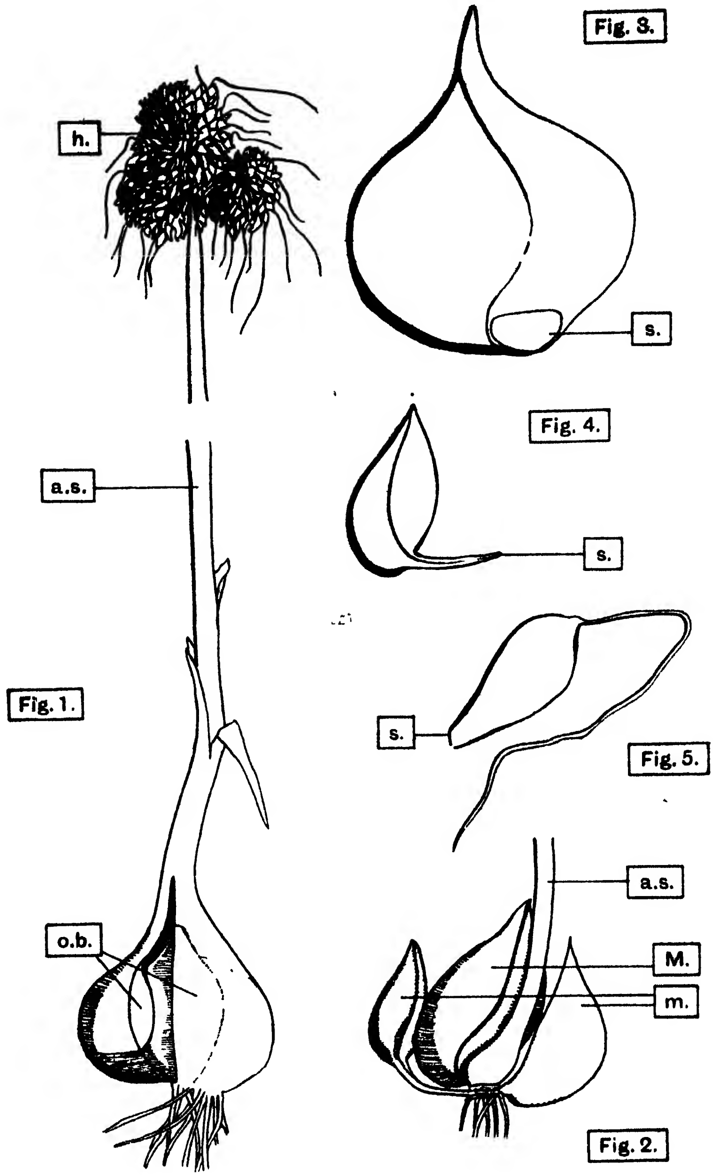

Fig. 1 Mature plant as found in July and August. h. head of bulbils; a.s. aerial stalk; o.b. offset bulbs, partly enclosed by leaf bases.

Fig. 2 Mature plant: underground parts with leaf bases removed. a.s. aerial stalk; M. major offset bulb; m. minor offset bulbs.

Fig. 3 Major offset bulb. s. scar of attachment to parent plant.

Fig. 4 Minor offset bulb. s. scar of attachment to parent plant.

Fig. 5 Bulbil. s. scar of attachment to aerial head.

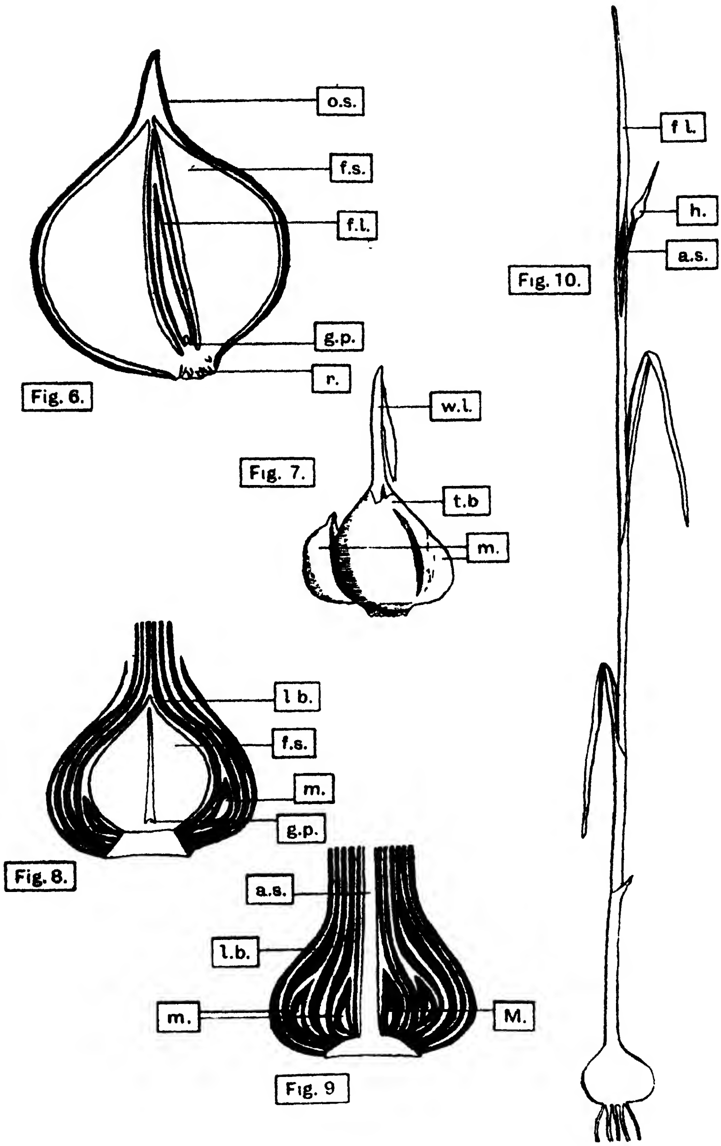

Fig. 6 Typical bulb cut lengthwise just before sprouting. o.s. outer scale; f.s. fleshy scale; f.l. foliage leaf; g.p. growing point; r. roots.

Fig. 7 Terminal bulb with minor offsets. w.l. withered foliage leaf; t. terminal bulb; m. minor offset bulbs.

Fig. 8 Section through underground parts of a growing plant in April, showing development of terminal bulb. l.b. foliage leaf bases (slightly swollen); f.s. fleshy scale of terminal bulb; m. minor offset bulb; g.p. growing point.

Fig. 9 Section through underground parts of a growing plant in April, showing development of stalk and offset bulbs. a.s. aerial stalk (formed by elongation of growing point); l.b. swollen foliage leaf bases; m. minor offset bulb; M. major offset bulb.

Fig. 10 Plant with aerial stalk as seen in mid-May. f.l. foliage leaf; h. young head; a.s. aerial stalk.

bulb is produced, this dying proceeds very rapidly during the latter part of May, by which time the new bulb is fully formed (Fig. 8). The aerial parts are usually quite dead by the end of June.

Where an aerial stalk is to be produced, the foliage leaves increase in number to five or six, and their bases within the bulb begin to swell in early March to produce a layered bulb. At the same time buds begin to develop in the axils of some or all of these bulb scales, commencing with that of the outermost and oldest leaf, and from these the lateral offset bulbs are formed. The major offset bulb, being that developed in the innermost leaf axil, is the last to appear. By the end of April a typical plant has grown to a height of 18–20 in. and the central axis has begun to elongate (Fig. 9) to form the stalk, which emerges from the innermost leaf about mid-May (Fig. 10). After further growth to a height which may vary from 1–5 ft., accompanied by a very great increase in tensile strength, the head, now swollen to a diameter of an inch or more, bursts the membranous bract which surrounds it, and the bulbils are exposed. These are practically fully grown and are frequently prolonged into a green leafy filament at the tip. This brings us to about the middle of June, by which time the offsets underground have swollen considerably and the outer scale surrounding each, which earlier was thick and succulent, has hardened into the tough fibrous covering of the ripe bulb. The foliage leaves have withered, and their bases have lost most of their fleshy character. This last process is completed by the end of July, leaving the mature plant which has already been described.

The Problem Such, then, is the nature of the weed plant to be controlled. Although found over a wide range of soil types, the wild onion appears to be a serious pest only when growing on heavy clays. These are, on the whole, unsuited to the growing of spring crops and are difficult or impossible to cultivate during the winter months, although this would seem the obvious line of attack on a plant which sprouts in early autumn and grows through the winter.

The wild onion is a weed of arable land and pasture alike, and renders the latter unsuitable for grazing certain types of stock; control by grazing is rendered more difficult by the fact that the onion appears to be palatable only during the early stages of its growth.

In cereal crops, the onion bulbils ripen at much the same time as the crop and are borne at about the same level above the ground. In addition, they are of approximately the same size and density as the grain. These features point to the obvious danger of spreading the weed in seed and straw.

The narrow cylindrical leaves, which have a waxy surface, make control by chemical means impracticable, and although considerable experimental work has been done with a large number of spraying agents, the method is at best costly and in no case has it been particularly successful.

The plant has a high reproductive capacity, and reference to the description of its methods of reproduction and the behaviour of the different bulb types makes clear the difficulty of total eradication of the weed. Removal of every growing plant in any season will leave large numbers of dormant bulbs untouched, and every growing plant that escapes destruction may yield one or two other such plants, more dormant bulbs, and a few hundred small plants (from bulbils) in the following season, which will themselves reproduce likewise in the course of time.

A completely successful programme of eradication must extend over a number of years at least equal to the maximum period of dormancy of the minor offsets, since it is difficult to see how these may be killed while still in a dormant state. Moreover, as 100 per cent. efficiency in the destruction of growing plants is not likely to be achieved in each season, complete success will most readily be obtained by a method which combines three factors, namely, the destruction of growing plants, the elimination of bulbil production, and the suppression of formation of dormant bulbs.

Attack on the Growing Plant The destruction of the growing plant is itself beset with several difficulties ; in almost every season there is a considerable reserve of food underground, which facilitates recovery from injury to root or shoot systems, and the growing point is in a well-protected position within the bulb. The time at which the old reserves of the parent bulb are exhausted and the new reserves in the foliage leaf bases have not yet accumulated, is a critical one in the life cycle, when the resistance of the plant is at a minimum and when cultivating operations are most likely to be successful. Even then, however, it might be desirable to repeat these, as not all the bulbs in any area will reach this critical stage at the same moment, and such operations will be further hampered, if not altogether prevented, by the fact that it is at this season (i.e., mid-February) that the heavy clay soils are least fit for cultivation.

By far the most thorough and systematic programme for eradication of the wild onion by special cultivation of the land is that advocated by Tinney in this JOURNAL,[1] and similar, although less rigorous, treatments have been suggested by Long (1929),[2] and by the United States Department of Agriculture (1929).[3] Tinney's recommendation of a rotation of spring crops over a period of six years, many of them intertilled crops, will clearly do much to destroy the plants in the middle of their growing season each year. It is claimed that late autumn ploughing will delay the production of minor offsets which can finally be prevented from forming by the spring cultivations. This method has clearly met with great success. The main objection to it, which has been put forward with some insistence, is that it may not always be practicable on the heaviest soils where this weed is prevalent, even having regard to Tinney's emphasis on the necessity of mole draining the land for a period of years before eradication is attempted.

Suppression of Bulbil and Dormant Bulb Production It will be observed that this treatment aims at the destruction of growing plants and at the same time claims to reduce the production of further supplies of dormant bulbs. This is indeed a difficult problem, but it has been found that the phenomenon of dormancy is closely related to the impervious nature of the outer scale in the minor offsets, for where this is ruptured the bulb does not remain dormant, and sprouting can be induced out of season by removal of the outer scale. The problem now becomes either how to prevent the outer scale from hardening or how to induce it to split before the autumn sprouting season commences. The first of these alternatives might be achieved by depriving the young offset of communication with the parent plant before the outer scale has hardened, thus checking the ripening process. This has been achieved on a small scale with offsets detached from 25 plants at the end of May, which all either sprouted or decayed within the following six months.

The second possible method of preventing dormancy in the offset bulbs seems, very fortunately, to be closely connected with the equally desirable prevention of bulbil formation. The outer scale of the minor offsets is usually intact in the smaller specimens and frequently split in the larger ones. It is suggested that the reason for this difference is that the inner bulbs continue to swell after the outer scale has hardened and is incapable of further growth. This scale consequently ruptures, a process which invariably occurs in the innermost (major) offset, and with decreasing frequency from the innermost to the outermost of the remaining bulbs. The latter stages of maturation of both bulbs and bulbils are mainly at the expense of the food stored in the swollen leaf bases, for the foliage itself is largely dead by this time. By removing the aerial heads just after they had burst (i.e., in mid-June), it was found that the size of the offset bulbs, presumably due to a redistribution of the available food supplies, was very much increased and the proportion of minor offsets in which the outer scale was ruptured was considerably higher than normal. This suggests that by cutting the stalk at an earlier stage, an even higher proportion (perhaps all) of the minor offsets might be induced to swell to a point at which the outer scale ruptures. Hence cutting the stalk will have the double advantage of both eliminating the bulbils and of checking the tendency to dormancy. It would appear that removal of the heads should be carried out, if possible, without damage to the foliage, and the operation will, therefore, be most simply performed when they have grown above the level of the latter. At this stage, however, the bulbils are probably capable of ripening independently, and the heads would therefore have to be collected and destroyed.

One of the first recommendations made for controlling the wild onion was that of Voelcker (1911),[4] who suggested the sowing of deep-rooted cover crops such as sainfoin, lucerne, or Elliot's mixture. He attributed the success of the method to the lightening effect of these deep root systems on the soil, but the occurrence of the plant over a wide range of soil types shows that there is no inherent incapacity of light soils to support the plant. The fact that such crops are cut two or three times yearly of course eliminates bulbil production, and may lessen the tendency to dormancy, as mentioned above. The smothering effect of such a crop is suggested by Long (1931)[5] as an explanation of its success, and while this is quite plausible, no direct evidence to that effect is available, and the precise reason for its efficacy is a matter which might well repay further investigation. Meanwhile the method clearly eliminates the bulbil from the life cycle. Various advantages of this have already been pointed out, but one other factor indicates that the bulbils play an even more important rôle in the maintenance of the species than their mere numbers suggest; this lies in their escape from injury by fungus diseases which destroy the larger bulbs.

Natural Enemies It has been found that in the heavily infested areas in the neighbourhood of Cambridge a very heavy toll of the larger bulbs is taken every summer by various fungus diseases, the most important of which are *Botrytis cinerea* and *Sclerotium cepivorum*, the latter being the organism responsible for white rot in the ordinary cultivated onion, *Allium cepa*.* Both of these fungi attack the underground parts of the plant during the summer, and cause a rotting of the offset bulbs, although no effect is generally seen above ground. The

* Whether the form of this fungus attacking *Allium vineale* can also infect *A. cepa* has not been established.

outer scale of the minor offsets appears to afford some protection, but the major and most of the minor offsets are frequently found completely rotted. *Sclerotium cepivorum* takes a form closely resembling a mass of lead shot in appearance, while the sclerotia of *Botrytis cinerea* appear as dark masses with a convoluted surface. Both fungi are easily recognizable when the bulbs are pulled in July and August.

Some idea of the prevalence of these two diseases is obtained from the fact that in July, 1942, while collecting bulbs (by pulling up the stalk) on a heavily infested area, 33 per cent. were found to be infected by *Sclerotium cepivorum*, while an even greater proportion of the stalks which came up leaving the bulbs underground bore traces of the fungus at the base. A considerable number were infected by *Botrytis cinerea*, and in July, 1943, this organism was found attacking about half the plants obtained in the same way on a similar site.

These data suggest that the prevention of bulbil formation over a number of years would, in such fungus-infected soils, result in a natural decrease in the density of infestation, and might, if combined with a cultural form of attack on the growing plants, reduce the density to a low level.

Hand Pulling Such methods as hand pulling or hand digging, though sometimes recommended, are, of course, only worth while where the area of infestation is very small, or the density of the weed is low. In such instances hand pulling can be a very effective means of control, if performed at the right season : done too soon, the green stalk breaks in one's hand ; done too late, the stalk comes up leaving the lateral bulbs below ground. Success in pulling depends on choosing the stage of greatest tensile strength of the stalk, before the offsets become readily detached from the parent plant. This stage has been found to occur at the time when the heads of bulbils are just bursting : in the summer of 1943 this occurred in mid-June, when 92 per cent. of the stalks pulled on a piece of heavily infested arable land brought their bulbs up with them. The stage of development was such that the heads of bulbils had burst out of the enclosing sheath in about half the population. The operation was found to be simplified to some extent when the surface soil was loose and slightly damp.

Recommendations When the problem of the eradication of the wild onion is studied in the light of the biology of the plant itself, certain recommendations as to its treatment can be made which would not otherwise suggest themselves, while those practices which have already been found successful receive theoretical justification. The net results of such an investigation may now be summarized briefly.

Winter growth and the early initiation of the new season's bulbs explain the need for autumn and spring cultivation advocated by Tinney, but on certain heavy clay soils treatment at these seasons may prove impracticable. The period of greatest susceptibility of the plant to cultivation probably occurs in mid-February, when its food reserves are most depleted, but as this point of development varies from plant to plant, cultivations at close intervals are desirable on those soils which permit cultivation at this season.

Where success attends the use of cover crops such as sainfoin, etc., this is probably largely due to the repeated removal of the fruiting heads, although root and shoot competition are possible factors which should not be ignored.

Elimination of bulbil production is of importance on account of the large numbers of these bodies and their high percentage viability, and it seems probable that any practice which removes immature heads will be particularly valuable on soils where a heavy toll is taken annually of the other bulb types by fungus diseases. There is reason to think also that such removal of the heads will have an indirect effect in reducing the tendency to dormancy among the minor offset bulbs, which at present constitutes one of the main obstacles to the eradication of the weed. It is the presence of the dormant population that necessitates the continuation of any cultural method of control over a period of years, and although this cannot be obviated, the period necessary might be shortened if, by persistent removal of the heads, additions to the dormant population during the years of treatment were prevented. Effective eradication is hardly possible with less than six years' treatment, for this seems to be the maximum period of dormancy for the minor offsets. Up to the present no controlled large-scale experiments have been made to investigate the results of beheading the stalks, nor has the factor of cost or relation to farm practice been considered. If attempted, it should naturally be accompanied by whatever other control is possible, particularly by cultural means, and should be continued over as many seasons as necessary.

Where the infestation is slight, or has been reduced to a low level by other methods, hand pulling is the best means of eradicating the remaining plants. This, however, is applicable only to plants with aerial heads, and must be continued over a period of years until all the plants present have reached this stage. Also, it is practicable only at a certain season and should not be practised at any other time.

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AMERICAN SOLDIER-FARMERS' DEVON TOUR

PAUL REED
The British Council

AMONG the many leave courses for members of the U.S. Forces arranged by the British Council in association with British Universities there have been two in agriculture at the University of Reading. They were most successful, and a demand for places much in excess of the number available demonstrated the existence of a keen and widespread desire among the Americans to study our farming methods. As it was impossible materially to increase the number of places at such courses at Universities and similar institutions, consideration was given to the experimental provision of a week's course in a rural area to be devoted mainly to farm visits and discussions with farmers and experts. War-time problems of accommodation and transport appeared, and subsequently proved, formidable, but the Chairman of the Devon War Agricultural Executive Committee, Mr. G. C. Hayter-Hames, and the Executive Officer, Mr. Colin D. Ross, and their colleagues generously undertook the organization, and by their enthusiasm, perseverance and ingenuity ultimately surmounted the difficulties.

Composition of the Party So, on February 21 last, there assembled at Bradninch Hall, Exeter, the headquarters of the Committee, 24 members of the U.S. Forces, ranging in rank from Colonel to Private, drawn from stations all over the United Kingdom, and selected from about 150 applicants. The party was limited to 24 for several reasons, among them the difficulty of enabling any larger number to make personal contacts with agriculturists—which was the primary aim. They came from nineteen States of the Union, and the majority were graduates in Agriculture, Agronomy, Agricultural Engineering or Animal Husbandry. Occupations in civil life represented were: farmer, veterinary surgeon, vocational agricultural instructor, livestock breeder, landscape engineer, agricultural journalist, research workers, manager of a co-operative grain elevator, and officials of Federal and State Agricultural Extension, Soil Conservation and allied services.

Accommodation and Transport The local branch of the National Farmers' Union arranged for as many as possible to be guests of farmers in the immediate vicinity of Exeter, and the remainder, through the good offices of the W.V.S., were guests of residents in the city. Transport was by special 'bus, and during the week the party travelled in all about 400 miles to various parts of the county. The U.S. authorities sent a film unit and a photographer to take pictures for circulation in the United States, and the B.B.C. broadcast to America an account and interviews with the members.

W.A.E.C. and W.L.A. The Americans showed great interest in the organization and operations of the War Agricultural Executive Committee itself, and were shown its Machinery Department, Workshops and Training Centre, the River Clyst Drainage Scheme, reclamation work being done by Italian prisoners, reseeding sites and new ploughing. They expressed great admiration for the work of the Women's Land Army, whose County Chairman, Lady Molesworth St. Aubyn, arranged visits to two hostels and a training school. They marvelled at the pluck and adaptability with which girls had come from the cities to face—in the words of one of the visitors—"the occupational hazards of sitting under cows and dodging jeeps in the narrow lanes".

Dairy Farming One of the most interesting days was devoted to dairy farming in South Devon. First, the party saw a self-supporting dairy farm of 51 acres, with a herd of 22 cows, which is run entirely by the owner, his wife and two daughters. He told how he had worked as a labourer, starting in his youth at a wage of 3s. a week, and had bought the farm out of his savings. The Americans were particularly interested in silage made in a galvanized iron container—silage-making methods were one of the topics most discussed throughout the tour, and the use of unchopped grass was new to many of the Americans. They were fairly astonished at the quality of some permanent pasture on this farm and took close-up photographs of the grass to show its texture and luxuriance. Only photographs, they said, would convince their folk at home that such fine pasture existed.

A contrast to this family farm were the Dartington Estate farms of 650 acres, with their two self-contained attested herds of 100 Tuberculin-tested South Devon cows—mostly pedigree—their magnificent buildings (designed as a result of a survey of farm buildings that ranged from Los Angeles to Berlin), their equipment, and the artificial insemination centre. A lively discussion on "Dairy Farms" was led by Mr. J. R. Currie, B.Sc., the Estate Economist, and advocates of dual-purpose breeds among the farmers present had to deal with a fire of questions and criticism from the visitors.

Later in the week there were visits to East Devon farms carrying herds of Friesians and Ayrshires, and to herds of North Devon cattle.

Sheep on Exmoor Very different farming conditions were seen when Earl Fortescue, Lord Lieutenant of Devon, conducted the party over his 8,000-acres Exmoor estate. The Americans were naturally surprised to find the shepherd in charge of the Cheviot Hill flock talking broad Scots, the explanation being that when one of Lord Fortescue's forebears brought the Cheviot sheep from Scotland he brought their shepherds too. The first batch was brought down about 1860, and the shepherds walked the flocks the last stage of the journey from Bristol to Exmoor. Even after generations on Exmoor, these families retain their Scots speech and characteristics. Here, also, there were Galloway cattle and Galloways crossed with Devons and Herefords.

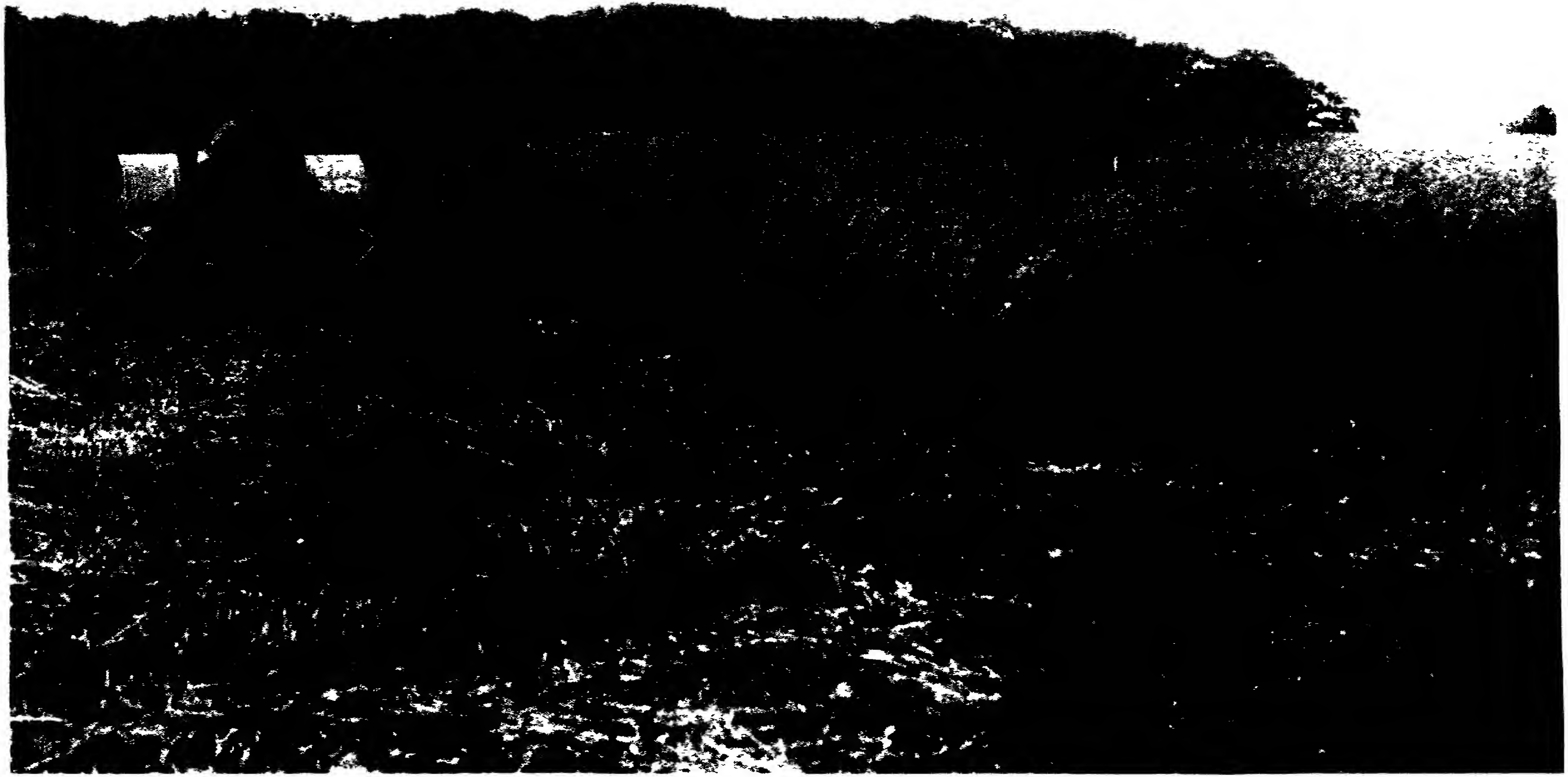
Agricultural Education A day devoted to agricultural education comprised visits to a new senior school with a rural science department and facilities for gardening and the keeping of live stock, and to Seale-Hayne Agricultural College, where the Principal, Mr. A. W. Ling, M.Sc., N.D.A., and his staff and students conducted the Americans over the buildings, research laboratories and estate. In a discussion which followed, the Americans asked about the extent of the teaching of economics in British agricultural education, emphasizing the great importance attached to this subject in the training of agricultural students in the United States. There was also a useful exchange of information about the activities of the American 4-H Clubs and our Young Farmers' Clubs.

At the Devon Cattle Breeders' Society's Show and Bull Sale at Exeter several of the Americans succeeded in placing the animals in the order in which they eventually appeared in the prize list—an achievement which greatly impressed the local farmers, as the visitors had never seen the breed before. It was thought that there are possibilities for the Devon breed in the United States as a "rancher" beef animal. At present there are only a few Devon herds there.

American soldier-farmers examine stock with a critical eye at the Devon Cattle Breeders Show, Exeter

Interest in a thatching machine which stitches straw to make lengths of thatch covering

(Photos. *Western Times*)



LUCERNE FOR THE NEW GROWER **(See pp. 155–157)** (Photo. *Lewis Jones*)

Seven-years-old field of lucerne and cocksfoot grown by Mr. T. E Marsh, at Knockin, Oswestry, Shropshire, grazed up to the end of April and then cut for hay

During the week there were visits also to nurseries, a cider factory, hatcheries and a poultry farm. It will be seen, therefore, that a great deal of ground was covered in five days, but the keenness of the Americans to get to know of British farming and its war-time production achievements never flagged. They gave a good deal of information in return, notably about the use of machinery of types that the United States has sent us during the war, and about experience with the newer varieties of artificial fertilizers.

From the British side, opportunity was taken to emphasize particularly our great indebtedness to the United States for such machinery as the caterpillar tractors, which have been invaluable in reclaiming large stretches of land for food production, and for the supplies of triple superphosphate that have so materially increased crop yields.

A Stimulus It was agreed on all sides that the course proved a great success. The Americans were enthusiastic and sincerely grateful for the opportunity. The Devon organizers felt that they had gained not a little by the exchange of ideas, and that the visit was a stimulus to farmers and to the War Agricultural Executive Committee and its staff in their campaign on the food front.

In its account the U.S. Army paper, "Stars and Stripes," referred to Devon's hospitality as "dazzling," but to one more familiar with Devon what was even more dazzling was the almost continuous sunshine and not a drop of rain for the whole week—in February !

MECHANIZATION IN MARKET-GARDENING

An abridged version of Mr. F. A. Secrett's paper read to the Institution of British Agricultural Engineers at the Royal Society of Arts on March 28, 1944

IT has been suggested that the mechanization of market-gardens will reduce labour requirements but, looking back, it is difficult to point to any mechanical or technical improvement in horticulture which has cut down labour bills. Invariably the gross annual expenditure per acre on labour has increased, but the corresponding rise in output has automatically reduced the cost per ton of produce. Increased efficiency leads to expanded production, and with mechanical implements the speed with which the operations are performed allows greater elasticity of labour, and enables the grower to utilize it on any particular crop at the right moment, thus reducing production costs.

Need for Research and its Application Unfortunately the use of mechanical implements on farms has preceded the education necessary for their proper and efficient use. Broadly speaking, the horticultural worker does not take kindly to mechanization ; he finds it monotonous—mainly because he has sufficient knowledge only to operate the machine.

Progress in mechanizing the horticultural industry is dependent upon adequate research, with the grower, research worker and manufacturer working in close collaboration. Standard equipment of proved efficiency is needed to replace that which is, in many cases to-day, a constant source of anxiety and annoyance and wholly unsuitable for the work it is called

upon to perform. So far the design and manufacture of small implements have been much too haphazard. For the small man the most useful tools are those capable of performing more than one operation, and they must be easily and quickly adjustable to various purposes; the design of many present-day machines does not allow this.

If mechanization in horticulture is to be successful, growers must take an active interest in the development of the industry as a whole, and in particular the research work in their own section.

Tractors and Ploughs The modern type of farm tractor is also suitable for use on the larger market-gardens. Deep ploughing and subsoiling are essential for the majority of our crops, and for this purpose the wheel tractor is satisfactory. For later surface cultivations, however, this is not so: the seedbed must be evenly consolidated and, if wheel tractors are used for drawing heavy rolls, etc., they invariably leave wheel marks in the crop, due to greater consolidation of the land by wheel pressure. For this reason horses are often employed, but it is possible that new and improved light tracklaying tractors may prove even more satisfactory than horses, and eliminate variation in the consolidation of the land.

Perhaps the most promising type of tractor for small horticultural farms is a medium tractor and coupled plough, operated by hydraulic lifting gear. Its manoeuvrability has proved it to be very useful on small acreages.

A single-furrow plough with subsoiling attachment is the most suitable type of plough for horticultural work; the land can then be ploughed with 9-in. furrows 12 in. deep and subsoiled a further 6 in. All cultivations for vegetable crops must be thorough, and definitely aimed at conserving moisture and completely aerating the soil.

Many growers plough their land with low-powered machines, with the result that the land is never ploughed as deeply as it should be; a pan is created and in time the whole area becomes acid and sour. If growers have no high-powered tractor available, they should hire one at least once a year and give the land the thorough cultivations which it requires.

Harrows and Cultivators The three types of harrows mainly used in horticulture are disc harrows, spring-tooth harrows and tooth harrows. Frequently the last-named have to be made to the grower's own design, since the teeth of the standard tool are too far apart for all market-garden crops. The disc harrow is the most reliable and useful for cultivations. For the final cultivations with tooth harrows and rolls, light horses are employed. To deal with close crops there is also need for lightweight row-crop machines of sufficient horse-power for the work, but capable of use by a youth or a land girl.

Cultivations by mechanical tools for crops planted or drilled 12 in. from row to row present many difficulties, since implements for this purpose are still far too heavy. The aim of a manufacturer should be to make small, reliable tools, capable of standing up to constant work. As far as possible, they should be designed so that the worker can watch the operation, and not be handicapped by being seated with his back to the tool.

The fruit section of our industry is still in urgent need of a high-powered small cultivating machine for use in orchards. This should be of a low design, fitted with extensions to allow cultivation under half-standard trees.

Drills No satisfactory market-garden drill has, in my opinion, yet been designed. The important operation of drilling seldom receives the care it warrants, and germination often fails in dry periods simply because the drill is unsuitable to the soil and climatic conditions. Brush drills, either of the single or three-coulter type, are in most common use to-day. We have no steerage drill for small seeds, so that however good the drill-men may be, variation in distance between the rows is bound to occur—a fault which a steerage drill would rectify.

Careful attention must also be given to the depth at which seed is sown ; some seed need be only just covered, whilst others should be 1½–2 in. deep. There seems no reason why the depth of sowing should not be regulated by adjustment of the drill instead of being left to chance, as it is to-day.

Rolls I am convinced that the firmness and compactness of the soil do not depend entirely upon the actual weight of the roll used ; the dimensions of the cylinders are also important. A light roll of small diameter compresses the ground more than a heavier roll of larger size. Certain soils require rolls of varying weights and sizes. A wooden roll leaves a different kind of surface from that left by an iron roll, and under certain climatic conditions it is far superior for preparing land in which small seeds are to be sown. It is not suitable for working down clods, but it is of very high value for obtaining a firm seedbed after general cultivations, and is also useful for rolling land which has been drilled.

These wooden rolls, however, do not appear to be manufactured on a large scale, and a grower usually has to have them made locally to his own specification. At the same time it is doubtful whether rolls will be in great demand until growers have been taught their correct use.

Planters The mechanical planter is an example of one of the greatest advances in mechanized market-gardening, but finality has not yet been reached. It is of extreme delicacy, and I have watched it at work planting leeks 1 ft. × 8 in.—a really amazing feat. At Milford, in Surrey, on the lower greensand, 40 acres of spring greens for bagging were planted at 1 ft. × 10 in., but the success of this work is largely dependent upon the skill of the tractor driver. There is a need for planting machines to set out quite small plants like lettuce. Experience has shown that machine-planted plants make a better start than those set by hand with steel dibbers ; the roots are more evenly spread, and they are not held in the hand or exposed to the sun and wind for a long period. Provided the machine is working efficiently, pressure is put upon the soil around the root of the plant in the correct manner ; whereas when planting by hand, men are liable to tighten the plant in the ground around the stem, leaving the root swinging in the cavity made by the dibber. The one drawback of a mechanical planter is that it cannot be used unless the ground is in a friable and fairly dry condition.

Manure Loaders and Distributors No farm operation is more extravagant of labour than muck spreading. Now that a large amount of straw is available and composting has come to the fore, it seems that the investigation of manure loaders might receive greater attention. Some farmers are using grabs for loading composted straw, and this is certainly a labour-saving device, although it leaves room for improvement.

It should be possible to invent a machine for turning the heaps when making compost—a most costly process when carried out by hand. Further investigation on the subject must depend upon the quantity of material composted annually, as the initial expenditure on such machines would not be justified unless the market-garden industry developed a serious interest in composting. It is to be hoped that vegetable growers will be converted to the use of compost, which would probably halve their troubles from pests and diseases. If the soil received a dressing of compost once a year, and the cultivations were carried out efficiently, they would reap a rich reward for the labour and time expended.

The chief obstacle to the spreading of manure is the varied nature of the material, but there is unquestionably a need for a manure distributor which will spread the material evenly: the result of uneven distribution can be observed in all parts of the country.

Dry and Wet Spraying Machines For the most part, existing dry and wet spraying machines used for the control of insect pests and diseases have worked satisfactorily. For such materials as derris dust, a light mobile sprayer is required, capable of working over crops and having the adjustment of nozzles and output which make spraying economically possible. Perhaps the use of compressed air to atomize and carry insecticides and fungicides will eventually supersede our water-borne sprays, with consequent saving in time, weight of machine, strain on operators and accessories needed to keep spraying units supplied with water. A place should be found on market-gardens for the vaporizing type of machine, now used so efficiently for aphis control on strawberries.

With the increased use of sulphuric acid sprays to control weeds, need is being felt for the design of efficient sprayers affording operators protection from injury. The type required is a light machine with a wide spread of spray, capable of being drawn by a small low-powered caterpillar tractor.

Soil Sterilization in Greenhouses and Heat Treatment of Bulbs Modern steam soil sterilizing equipment has proved efficient but very clumsy, and after the war we may look for considerable improvement. If the heat treatment is used for horticultural crops, a standard sterilizing equipment would be beneficial. Research on this subject has engaged the attention of Seale-Hayne College, and their findings have proved very useful to the industry, especially with regard to the design of tanks and equipment.

Irrigation It is remarkable that so little interest has been taken in irrigation, especially in view of the high water content of market-garden produce. It may be that our climate gives growers a sense of security, but after many years' experience of working farms with and without irrigation plants, I have come to the conclusion that an adequate water supply is essential on every well-organized holding. This is another instance of the mechanization of market-gardens leading to the employment of extra labour, for unless this is available full advantage cannot be taken of any irrigation plant.

Besides making the grower independent of seasonal rainfall and improving the quality and succulence of vegetables, pests and diseases, which are prevalent during periods of drought, can be controlled effectively by the correct use of an irrigation system. Immediately the land becomes vacant it can be worked and cropped again, and production is speeded up during the periods of drought, when prices are always high. Also, if the

irrigation plant is capable of running at high pressure, fertilizers or insecticides can be added to the water before distribution, and trace elements in very small quantities can be distributed easily and evenly in solution,

An irrigation plant enables a grower to plan his cropping with confidence: haphazard production has been the curse of our industry. Many growers are mainly concerned with the needs of provincial towns, which necessitate their growing for definite markets when local produce is not available, or in short supply. This condition may exist only for periods of 10–14 days, so that the timing of some crops becomes a most important factor. The regulation of this timing can be achieved only with the assistance of an irrigation plant.

River, stream or well water is preferable to total reliance on the local water company, and care must be taken to see that there is no pollution by effluents from industrial works. Before wells are sunk, the Geological Survey should be consulted for information concerning the strata to be penetrated and the depth at which subsoil water may be found. This depth and the actual formation from which water is drawn will largely determine the type of equipment necessary for lifting. In some cases, deep well pumps should be used, whilst in more shallow wells, centrifugal pumps are suitable. Where the water is taken from sand, lifting by air is, perhaps, the best method.

Design and equipment will, of course, vary with the particular conditions. If the water is taken from sand, filters may have to be fitted at the bottom of the tubes before the water can be lifted into the reservoir. Although a little more expensive in running costs, electric motors are preferable to Diesel engines; they do not need the constant attention which the latter demand.

The horse-power of the motors will depend upon the area to be irrigated and the pressures required. My system at Milford is designed to irrigate 150 acres, and is fitted with two 15 h.p. motors which drive the compressors for lifting the water, and a 30 h.p. motor driving a four-stage centrifugal pump. This plant is capable of watering 4 acres at one time with the equivalent of 1 inch of rain in 8 hours. The mains are 4 in. in diameter, reducing to 3 in., and a pressure of 80 lb. per square inch is maintained over the whole system when the plant is delivering at full capacity. I prefer overground mains, supported on concrete dollies about 2 ft. above ground. The mains should be 500 ft. apart with dual valves fitted at every 30 ft., to which the spraying lines are attached by means of rubber hose. The spraying lines are purchased in short lengths with easy couplings, and are erected on light steel chairs 18 in. in height. With such a system the spraying lines are 250 ft. long, and equal distribution is assured. A reliable engineer should be consulted for the lay-out of the mains, as correct planning reduces running costs and often the horse-power of the motors by cutting down friction loss.

If a hydrautomat is installed in the engine house, saturated solutions of nutrients or insecticides can be injected in the mains. Experience has proved that crops benefit from minute quantities of plant food applied in this manner. I use nutrients in the proportion of from 1 in 20,000 to 1 in 30,000. Special aeration plant to increase the oxygen content of the water has recently been designed.

Good Lay-out and Better Packing Sheds

Mechanization of large or small farms makes correct lay-out a necessity. Increased production, good equipment and heavy crops demand good roads. Small growers cannot aspire to concrete roads but some substitute should be found.

Packing sheds are a disgrace on the majority of market-gardens; in many cases they are only adapted farm buildings. In the future growers will have to give more attention to grading and packing, and well-designed sheds will become necessary. I see no reason why packing sheds should not be standardized, heated in the winter and fitted with proper equipment for washing, grading and packing produce.

During the last few years efficient grading machines for apples and tomatoes have come into general use. Root washing machines have been installed in many of the large market-gardens in the eastern counties, but machines of a lighter, and possibly more portable, nature are necessary for small growers. Washing vegetables by hand in winter months is one of the most unpleasant jobs that can be given to any girl.

If the horticultural industry is to play its full part after the war, it must concentrate on maximum production of well-graded, highly nutritious products, so that this island may continue to play the same part in feeding the nation as it has done during the past four-and-a-half years of bitter struggle.

Reproduction of this paper and discussion *in extenso* will appear in the November issue of the Proceedings of the Institution of British Agricultural Engineers, obtainable from 58, Gordon Square, London, W.C.1., price 2s. 6d. post free.

EXTRACTION OF TOMATO, CUCUMBER AND MARROW SEED WITH HYDROCHLORIC ACID

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EXTRACTION of tomato and cucumber seed by the use of commercial hydrochloric acid has been reported by E. M. Hatton in Australia.* By this method the seed sacs are dispersed in 30 minutes, whereas by the normal fermentation method the process may take up to four days, according to the temperature. Trials of this method of extraction have been conducted at Cambridge with tomato, cucumber and marrow to gain experience of the technique and to ascertain whether the volume of commercial acid (32 per cent.) needed in this country is the same as that used in Australia. Germination tests with the extracted seed, made by the Official Seed Testing Station at Cambridge, have shown that every sample has held its germination satisfactorily after a period of six months.

Tomato Trials were carried out with tomato, using a pulp of the whole fruit, to test:

(a) the efficiency of extraction in a standard time of 30 minutes with varying volumes of acid;

(b) the efficiency of extraction in a standard time of 60 minutes with varying volumes of acid; and

(c) the effect of large volumes of acid on the germination of the seed.

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The results of these trials are summarized in Tables 1, 2 and 3.

Further trials were also carried out to test:

(i) the efficiency of the acid method of extraction, using only the inside pulp of the tomatoes;
(ii) the possibility of extracting seed on a commercial scale;
(iii) the effect of temperature on the ease of seed extraction.

As a standard of comparison in these tests, a sample of seed extracted from pulp which had been fermented for 96 hours was used; this seed had a germination of 75 per cent. after four days and 93 per cent. after eleven days. In appearance the sample was fairly bright and free from mucilage.

For trials (a), (b) and (c), ripe fruits of the variety Ailsa Craig were used. The fruits were cut in half and pulped; the acid was then added to the pulp, which was stirred both then and again three or four times during the process. At the end of the treatment the pulp was washed with water through a 6-mm. sieve, which retained the skin and large pieces of pulp. The seed, small pulp and water which passed through the sieve were caught in a bowl; the good seed sank to the bottom and most of the water was then poured off, taking with it much of the pulp and small seeds. After washing and decanting several times, the good seed was tipped on to a fine sieve, again washed thoroughly, and finally spread on muslin cloths to dry.

TABLE 1

SERIES (a)—EFFICIENCY OF EXTRACTION IN A STANDARD TIME OF 30 MINUTES WITH VARYING VOLUMES OF ACID

SAMPLE No.	VOLUME OF ACID PER LB. OF PULP	PERCENTAGE GERMINATION		DESCRIPTION OF SEED SAMPLES AFTER DRYING
		Interim (4 days)	Final (11 days)	
1	cc. 12	91	98	Dull colour, with pieces of mucilage in the sample.
2	16	85	99	Slightly dull. No mucilage. Fair sample.
3	20	89	99	Bright colour. No mucilage. Good sample.
4	24	97	99	Bright colour. No mucilage. Good sample.
5	28	90	99	Bright colour. No mucilage. Good sample.
6	32	91	98	Bright colour. No mucilage. Good sample.

From this Table it will be seen that whilst seed of good germination was obtained in each test, the seed was of best appearance when 20 cc. or more of acid were used.

TABLE 2

SERIES (b)—EFFICIENCY OF EXTRACTION IN A STANDARD TIME OF 60 MINUTES WITH VARYING VOLUMES OF ACID

Sample No.	Volume of Acid per lb. of Pulp	Percentage Germination		Description of Seed Samples after Drying
		Interim (4 days)	Final (11 days)	
	cc.			
1	4	80	93	Discoloured and covered with mucilage. Poor sample.
2	8	78	99	Slightly dull. No mucilage. Fair sample.
3	12	78	99	Bright colour. No mucilage. Good sample.
4	16	71	98	Bright colour. No mucilage. Good sample.
5	20	74	98	Bright colour. No mucilage. Good sample.
6	24	83	97	Bright colour. No mucilage. Good sample.

It will be seen that whilst the seed in each test of this series was quite good, the percentage germination in 4 days in series (b) was lower than that in series (a).

As in series (a) the best results were obtained when 20 cc. or more of acid were used. From this it appears that it is not possible to reduce the volume of acid by extending the period of treatment.

TABLE 3

SERIES (c)—EFFECT OF LARGE VOLUMES OF ACID ON THE GERMINATION OF THE SEED

Sample No.	Volume of Acid per lb. of Pulp	Percentage Germination	
		Interim (4 days)	Final (11 days)
	cc.		
1	20	85	97
2	40	90	96
3	60	66	94
4	80	65	99
5	100	43	87
6	120	78	90
7	140	88	98
8	160	87	93
9	180	88	94
10	200	77	96

In this series the time of treatment was 30 minutes. Although all samples exhibited a bright colour after drying, those treated at higher concentrations

became slightly discoloured after a few days. The germination was not affected by the acid treatment in any tests in this series.

(i) EFFICIENCY OF THE ACID METHOD OF EXTRACTION USING ONLY THE INSIDE PULP OF TOMATOES Since some growers use only the inside pulp of tomatoes for seed extraction and sell the outside flesh, a further test was made in which the inside pulp alone was treated with acid. By this method it was found that a larger amount of acid per lb. of pulp was needed, probably because bunches of seed tend to cling together more than when whole tomatoes are pulped, thus escaping the action of the acid. The minimum quantity at which good samples of seed were obtained was 25 cc. of hydrochloric acid to 1 lb. of inside pulp.

(ii) POSSIBILITY OF EXTRACTING SEED ON A COMMERCIAL SCALE To test this method on a commercial scale, bulks of 6, 10 and 56 lb. of whole tomatoes were pulped and treated for 30 minutes with 25 cc. of acid to the pound. Excellent samples of seed were obtained in this way. When 8 lb. of inside pulp were treated in the same way the sample was inferior in quality, thus confirming the necessity for larger volumes of acid when treating inside pulp.

(iii) EFFECT OF TEMPERATURE ON THE EASE OF SEED EXTRACTION Tests were carried out in October, 1943, when the weather was cool and the temperature of the pulp was 63°F. To test the effect of temperature, pulp was kept at 93°F. during the acid treatment, and very good samples of seed were obtained using only 10 cc. of acid to 1 lb. of pulp. The increase in labour costs would probably not compensate for the decrease in cost of acid if heating of the pulp is practised, but if this method of extraction were carried out earlier in the year, when the temperature is higher, or in heated greenhouses, the amount of acid necessary for extraction would possibly be less than it was in the first tests.

The Australian trials were carried out "during hot weather," when the fermentation method of extracting the seed used as a control took only 24 hours, whereas several days are usually needed to complete the fermentation process in Britain. It is probable that the reason why larger quantities of acid are required to carry out the process successfully in this country is due largely to the lower temperature of the pulp.

CHESHUNT PRACTICE A method which has been successfully practised at the Cheshunt Research Station for many years consists of adding a 10 per cent. solution of washing soda to an equal bulk of tomato pulp. The mixture is usually left overnight and no difficulty has been experienced in cleaning the seed with water the following day.

Cucumber Two series of trials, which are summarized in Tables 4 and 5, were carried out on the pulp from the gherkin type of cucumber to test:

(a) the efficiency of extraction of the seed in a standard time of 30 minutes with varying volumes of acid;

(b) the effect of large volumes of acid on the germination of the seed.

Two controls were used:

(i) seed extracted from pulp which had been fermented for 96 hours;
(ii) seed which had been washed only without fermenting.

The fermented seed gave a germination of 99 per cent. after four days, and was bright and clean in appearance. The seed which had been washed gave a germination of 88 per cent. after four days, and a germination of 97 per cent. after eleven days. The sample was discoloured and covered with mucilage.

For trials (a) and (b) a number of cucumbers were cut in half lengthwise, and the pulp and seed scraped out and bulked. The temperature of the pulp was 61° F. The pulp and seeds were mixed with the acid and the seed was removed from the pulp in the same way as the tomato seed, washed thoroughly and spread out on butter muslin to dry.

TABLE 4

SERIES (a)—EFFICIENCY OF EXTRACTION OF THE SEED IN A STANDARD TIME OF 30 MINUTES WITH VARYING VOLUMES OF ACID.

SAMPLE No.	VOLUME OF ACID PER LB. OF PULP	PERCENTAGE GERMINATION		DESCRIPTION OF SEED SAMPLES AFTER DRYING
		Interim (4 days)	Final (11 days)	
	cc.			
1	4	99	99	Slightly discoloured dried mucilage (now membranous) adhering to seeds; difficult to remove from drying cloth.
2	8	9	99	A good sample, clean and bright.
3	12	99	99	A good sample, clean and bright.
4	16	99	99	A good sample, clean and bright.
5	20	99	99	A good sample, clean and bright.
6	24	98	98	A good sample, clean and bright.
7	28	98	99	A good sample, clean and bright.

From this Table it will be seen that all samples gave a good germination. In appearance, there was a slight gradation in brightness of the samples, number 7 being perceptibly brighter than number 2, although the difference between numbers 2 and 3 was imperceptible. All compared favourably in colour with the controls, with the exception of number 1 which was dull in colour. A minimum of 8 cc. of acid per lb. of pulp was needed to produce a good sample.

TABLE 5

SERIES (b)—EFFECT OF LARGE VOLUMES OF ACID ON THE GERMINATION OF THE SEED

Sample No.	Volume of Acid per lb. of Pulp	Percentage Germination	
		Interim (4 days)	Final (11 days)
	cc		
1	20	99	99
2	40	89	96
3	60	88	95
4	80	92	98
5	100	86	95
6	120	90	98

In this series the time of treatment was 30 minutes. All seed showed a good germination, but after four days was not as even as in series (a). At first samples were bright in colour, but after a few days those treated with higher concentrations became slightly discoloured.

Marrow Trials were carried out with marrows to determine whether there was any advantage in using acid for extracting the seed. They were divided into two series to test:

(a) the efficiency of extraction of the seed in a standard time of 30 minutes with varying volumes of acid;

(b) the effect of large volumes of acid on the germination of the seed.

Results are summarized in Table 6.

Pulp and seed were scraped out from overripe, hard marrows. A number of samples of the inside pulp, each weighing 1 lb., were treated with different volumes of acid in the same way as the cucumber seed, and the seed obtained compared with unfermented washed seed and fermented seed.

The washed, unfermented seed germinated 86 per cent. after four days and 98 per cent. after eleven days. The fermented seed germinated 61 per cent. after four days, and 98 per cent. after eleven days. Both samples were clean and bright in appearance.

TABLE 6

Sample No.	Volume of Acid per lb. of Pulp	Percentage Germination	
		Interim (4 days)	Final (11 days)
	cc.		
Series (a)			
1	2	66	98
2	4	64	99
3	6	71	97
4	8	60	99
5	10	64	99
Series (b)			
1	20	45	97
2	40	19	89
3	60	1	51
4	80	0	24
5	100	0	16
6	120	0	0

All samples were clean and bright in appearance and free from mucilage, and since there was no difference in germination between the washed and fermented seed and the samples in series (a), there appears to be no advantage in treating marrow seed with acid. It will be seen from series (b), where the time of treatment was also 30 minutes, that quantities of acid greater than 20 cc. per lb. of pulp had the effect of lowering the percentage germination, until on the addition of 120 cc. of acid the germination was nil.

It should be noted that in these trials marrow seed was extracted successfully without acid by washing only. In commercial practice washing alone is not always satisfactory, and fermentation before washing is found to be necessary to obtain a bright sample of seed. When this is the case it is possible that acid treatment might compare favourably with fermentation.

Summary and Recommendations Preliminary trials in the extraction of seed of tomato, cucumber and marrow with hydrochloric acid were carried out at Cambridge in autumn, 1943.

At a temperature of approximately 60°F. (15.5°C.) good samples of tomato seed were obtained by treating pulp of fruits for 30 minutes with commercial hydrochloric acid, and it is recommended that 25 cc. of acid be used to each 1 lb. of fruit. If only inside pulp is used slightly more acid is needed—30 cc. per lb.

Cucumber seed can be extracted from pulp with smaller quantities of acid, and 10 cc. per lb. of pulp is recommended.

Tests with marrow were confined to hard, overripe fruit, and the acid method of extraction showed no superiority over the ordinary method of washing with water.

In extracting any of these classes of seeds with hydrochloric acid, it is advisable to use wooden tubs or earthenware bowls for the treatment, since if galvanized iron or tin receptacles are used, the action of the acid on the metal may form deposits which will spoil the colour of the seed.

THE PROTECTION OF BENEFICIAL BIRDS

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A necessary preliminary to any discussion on the protection of beneficial birds is an answer to the question—which *are* the beneficial birds?

It must be admitted that the determination of the food of wild birds generally is a complex and difficult task. While it is true that there are (a) certain species, the nature of whose food can be determined beyond reasonable doubt and whose capacity for good or harm can be confidently assessed; and (b) many species in whose case an approximation of diet can be sufficiently accurate to indicate in which category they should be placed; it is also true that there are (c) others, mainly of omnivorous or at least mixed feeding habits, whose diet as a whole is extremely difficult to determine and which have long been the subjects of controversy.

Birds whose Food Habits are Known Under (a) two species will suffice as examples—the barn owl and the wood-pigeon. The classification of the contents of pellets cast up by owls has been brought to something very like an exact science, with the result that the barn owl's position near the head of the list of beneficial British birds is now unchallengeable. Field observations and careful and critical examinations of crop contents of the wood-pigeon, carried out at all seasons of the year, justify the assertion that this bird is one of the worst if not the worst feathered pest with which the farmer has to deal. To kill a barn owl (or indeed any other species of owl) is an offence against the law and a crime against common-sense. To shoot a wood-pigeon is both legally and economically justifiable.

Under (b) fortunately may be included a host of insectivorous birds, among them such useful species as the swallow, the martins, swift, the wagtails, the pipits, robin, wren, wryneck, dunnock, the tits, the flycatchers and the nightjar, all of which are protected by law.

Birds of Mixed Feeding Habits Under (c) may be cited the outstanding example of the rook. At the present time no one can say exactly how the rook stands in relation to British agriculture as a whole. Mere opinion based on casual observation is worth nothing. The man who "knows" that the rook is a pest and leaves it at that is not worth listening to, any more than is the man who "knows" that the bird does no harm whatever. Loose generalizations of this kind have done more than anything else to obscure the true character of certain of our birds. It was not so long ago that some 90 per cent. of those who were interested "knew" that the little owl was a pest of the first order, whereas the first properly conducted inquiry at the Edward Grey Institute of Field Ornithology, Oxford, showed conclusively that on balance it was a beneficial bird. It is precisely because there are such widely differing opinions on the rook that the British Trust of Ornithology, at the request of the Ministry of Agriculture, is now engaged in a new inquiry into its habits. This inquiry will be conducted by experts on sound scientific lines ; it will cover all seasons of the year, different types of farming with especial reference to war-time changes in farming practice, population, distribution, feeding habits, and systematic examinations of stomach contents of rooks. In short, it will be the only kind of investigation that is worth while.

Impact of War-time Agriculture on Bird Life Turning now to the question of protection, it is clear that we may safely proceed on the assumption that the great majority of British birds are, on balance, beneficial, and are therefore worthy of all the protection that we can give them ; and it will be as well first to consider the reasons why protection is more necessary to-day than it has ever been and to examine the causes of the anxiety that has been expressed in many quarters.

During the war certain physical changes have occurred in our countryside. In the main these changes have been brought about by the "tidying up" of the land, which has been a feature of the intensive drive for increased food production. It may be said at once that most of them have been inseparable from and indispensable to our war effort and that they must be regarded as inevitable ; nevertheless their effects on our bird life have to be reckoned with. It is possible to exaggerate the importance of such changes, and it is too early to judge the full result of their impact on our bird population as a whole. But meanwhile it can be said that they have

caused a disturbance of balance, that in some districts, in some degree, they have caused dispersion or redistribution, or both, of bird populations, and that for the most part they have borne more hardly on the beneficial species than on the others. The clearing of scrub and waste land, the felling of timber, the removal of undergrowth, and the lopping of hedges have all been material factors. While there are sound agricultural reasons why hedges should be kept properly cut and trimmed, the practice of razing them to the ground, prevalent in some districts, has nothing to recommend it. To some extent these various operations have reduced the natural nesting cover of many species of birds, and dispersion or redistribution may have resulted in overcrowding and a shortage of natural nesting sites elsewhere, or may have compelled birds to nest in unsuitable situations, where they have become easy prey for their enemies. There is, in fact, considerable evidence in support of both these suggestions.

Coincidentally with the changes referred to above there has undoubtedly been an increase in the numbers of certain species, notably the carrion crow, magpie, jackdaw and jay, at least three of which are inveterate egg thieves and destroyers of young wild birds. With the exception of the carrion crow, it is possible that on balance all these members of the crow family, in reasonable numbers, may be beneficial, but there is no doubt that an undue increase in the numbers of any of them is undesirable.

Bird Consciousness among the Public A third factor which has to be considered is the distressing revival of catapulting and bird-nesting by children and adolescents. Last year this trouble assumed disquieting proportions, and this year the position has been little better.

Birds are important at all times, and especially in war time, and admitting as we must that better protection is to say the least desirable, what can be done about it? It would seem that the most useful step lies in the direction of better education of the general public, and especially of its younger members, in the vital importance of birds and the work they do for us all. In this matter parents and teachers can be invaluable. They themselves need little if any urging to refrain from molesting birds or harming their nests or eggs, but they should do everything in their power to persuade children and adolescents under their care not to do these things. We may leave to the sociologists the question whether our youth of to-day is as amenable to discipline and persuasion as was the rising generation in the first world war, but it is probable that at the present time the best opportunities lie with school teachers. Even to-day, "what teacher says" goes a long way with the very young.

The public generally should be brought to realize that, if at any time it should become necessary to reduce the numbers of our few harmful birds, this work must be left to experts who know what is required and how best to do it. The belief that countryfolk on the whole are well able to distinguish between one species and another is, unhappily, unfounded. No better illustration of this fact could be offered than the work of the sparrow clubs which were once so prominent a feature of our countryside but which, for very good reasons, are now discouraged. A collection of "sparrows" handed in for the usual reward of so much per head included the following birds: 27 house-sparrows, 8 dunnocks, 5 hen chaffinches, 2 meadow pipits, 1 willow warbler and 1 garden warbler. There is no reason to believe that this collection was exceptional; on the contrary, it is to be feared that it was typical of such collections up and down the country.

More Nest-boxes We may now consider one outstanding means of doing something really practical in the cause of bird protection. Recently there has been a gratifying revival of interest in nest-boxes. It is true that nest-boxes will attract only a limited number of species, but it happens that these are among the most useful of all our birds. A properly made nest-box will always interest most members of the tit family, while a box of the half-open type will be used by birds such as the robin, pied wagtail and spotted flycatcher. In at least one instance a specially designed nest-box has been occupied by a family of greater spotted woodpeckers, and on several occasions wrynecks have accepted these ready-made homes. A recent census of birds occupying nest-boxes in a fairly large suburban garden gave two pairs of blue tits, one pair of great tits, one pair of robins and one pair of spotted flycatchers. No nest-box in this garden was left unoccupied, and provided that due attention is given to spacing and each pair of birds has plenty of room, such a result is a possibility in any suitable garden.

Summing Up It is a healthy sign that more members of the public are taking an interest in bird life. One significant straw in the wind is the greatly increased interest of the Press in the activities of the British Trust for Ornithology and the Edward Grey Institute of Field Ornithology. In the earlier years of its existence the Trust did much good by stealth, but it was rarely mentioned in print, and the public knew little or nothing about it. This body is now engaged on several investigations, and two of these—the inquiries into the habits and status of the wood-pigeon and the rook—are of direct economic importance. They are attracting considerable attention, and many members of the public, farmers, and national and local agricultural organizations are helping to collect evidence. When eventually the results become available they seem assured of wide publicity and a sympathetic reception from a community that is rapidly finding more use for science than superstition in its attitude to natural history.

To sum up, the following seem to be the principal measures that can be taken in the cause of protecting our beneficial birds :

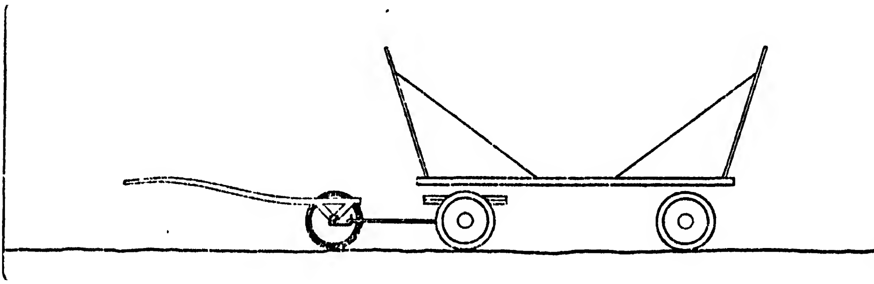
(1) Periodical reminders to the public of the great importance of birds, and requests to parents and teachers to persuade children and adolescents not to molest any wild bird or to interfere with its nest or eggs ;
(2) Periodical requests to the public to leave any necessary measures of control to experts who know what is required and how best to do it ;
(3) A campaign to encourage a more extensive use of nest-boxes in country and suburban gardens. By the autumn of this year (autumn is the time when nest-boxes should be put up) the Ministry of Agriculture's Advisory Leaflet No. 212 will have been reprinted, and copies will be available to the public on request.

SAVING TRACTOR TIME AND FUEL WHEN LEADING CORN

National Institute of Agricultural Engineering, Askham Bryan, York

If tractors and trailers are used for leading during harvest a great deal of tractor time and fuel can be wasted during loading ; and the tractor engine is often damaged by idling or running at extremely light loads for long periods. These troubles can be reduced substantially if a horse is substituted for the tractor during the loading period. This can be done

by providing a simple frame on two wheels carrying a pair of shafts and a hitch point (see illustration). The frame can be made on the farm from wood or steel and carried on a pair of steel wheels or an old car axle. The shafts can be "borrowed" from another implement not in use at the time.



By using such an attachment, one tractor can handle three trailers quickly and efficiently. For example, one trailer can be standing at the stack for unloading, another, with a horse, can be loaded in the field, while the tractor is drawing the third. This system is simplified by using four-wheeled trailers, but is also feasible with two-wheeled trailers. With the latter it is essential to fit some permanent jacking system on each trailer drawbar. This can be accomplished quite cheaply by fitting car jacks of the "built-in" type, such as are obtainable at most car-breakers' yards.

FARMING NOTES

Influence of Environment on Milk Production Whilst heredity in dairy cattle remains the most important single factor in milk production, environment has a considerable influence. This fact is brought out in a recent report by Professor Bonsma of the Agricultural Research Institute, Pretoria. He shows, for example, the marked disparity which exists between the productive life of Friesians under parched South African conditions and that on their native Friesland pastures. In South Africa maximum production is reached at six years of age—two years earlier than in Friesland—and an appreciable decline in production is observed thereafter.

The earlier and more rapid decline in production can be ascribed, in Professor Bonsma's view, to deficiencies in feeding and management. Over the many generations in which the South African stock has been evolved from the original importations from Holland, conformation and productivity have been shaped by the nature of the soil and vegetation, the climate, and the South African traditional methods of husbandry. Under the Friesland conditions the mixed clover pastures provide a succulent, easily digested and protein-rich ration during the summer, whereas South African pastures are generally of low nutritive value, except during the spring flush. Again, on their native pastures Friesians are milked in the field instead of having to walk considerable distances to the milking sheds. Lack of shade during the hot South African midsummer adds to the animals' discomfort and loss of energy. Even where shade is available, grazing is restricted to the cooler parts of the day.

If stock are to be fully productive their environment must harmonize closely with their hereditary potentialities. Adequate proteinous and succulent feeds must obviously be provided in the dry season, and it is here

that Professor Bonsma suggests that lucerne offers a solution to the problem. If cut young and frequently, it can be made into a first quality hay or preserved as silage for winter feeding. Combined with a balanced concentrate ration, both growth and milk production can be greatly improved.

A long record of consistently good yields is more important and a greater achievement than an individual high record. Indeed, success in forcing a high record of production during the first or second lactations may lead to reduced fertility and a shortened life.

In view of the intimate association which exists between developmental growth and long-range production, the careful feeding and management of calves and heifers prior to calving is of supreme importance. Deficiencies in nutrition of young stock which will affect optimum growth will also adversely influence subsequent production.

Roadside Stands for Milk Churns Ideally, there should be as little delay as possible in the transport of farm milk supplies, but where churns are brought to the roadside for collection by a regular lorry service, a waiting period is inevitable. In these circumstances the provision of roadside stands becomes imperative, as undue exposure to the sun may cause rapid souring of the milk. These stands should provide shelter from the sun and convenient loading facilities to minimize rough handling of the churns.

In selecting a site for a roadside stand, advantage should be taken of existing shade from buildings, walls, banks, hedges or trees and, wherever practicable, the stand should be close enough to the nearside of the road and its platform at the right height from the ground (usually 3 ft. 6 in. to 4 ft.) to allow direct loading on to the lorry. It is important that these stands should not obstruct the carriage-way and that the materials used in their construction should, as far as possible, be in harmony with the surroundings—not a constant eyesore. In every case, however, a rough ground plan of the site and a sketch of the proposed stand must be submitted for approval to the local Highways Authority.

Design and construction will vary according to available materials and the nature of the site. It should, however, be strong and durable and large enough to hold both the full and empty churns. The roof and sides which are exposed to the sun should be covered with material which will provide shade and insulation. Air circulation can be obtained by allowing spaces running from back to front between the flooring and at the top and bottom of the enclosed sides.

Gages and Greengages The following list of gages and greengages has been compiled in consultation with the chief Fruit Trial Stations, and should be useful in connexion with the Ministry of Food's Plums (Maximum Prices) Order, 1944, in which these fruits are included in Group II.

Brahy's Gage	Guthrie's Late Greengage
Bryanston	Jefferson's
Cambridge	Early or July Greengage
Coe's Golden Drop	Kirke's Blue
Coe's Violet	Late Transparent
Coe's Crimson Drop	Laxton's Gage
Count d'Althan	McLaughlin's Gage
Denniston Superb	Old Greengage
Early Transparent	Old Transparent Gage
Golden Transparent	Pullin's Golden
Greengage	Reine Claude de Bavary
	Washington

Fruit Picking for Co-operative Fruit Preservation Centres The Women's Institutes are again setting up centres to preserve both fruit from private gardens and orchards and wild fruit surplus to local requirements. It is important that no fruit shall be wasted for lack of picking. Last year many blackberries which could have been made into jam at the centres were left to rot on the hedges. Boy Scouts, Girl Guides and school children are being asked to help as in previous years, but this year the help of the Emergency Land Corps and Volunteer Land Clubs may also be sought, specially for the collection of wild fruit. Members of the general public are also asked to volunteer for this work, and should make inquiries at their nearest Citizens Advice Bureau.

The controlled pickers' price is paid for wild fruit by the centres. For garden or orchard fruit, payment for picking, if required, is a matter for individual arrangement between the pickers and the owners of the fruit trees.

OFFICIALLY APPROVED INSECTICIDES AND FUNGICIDES

Since the date of the list published in the March issue of this JOURNAL (p.574) the following have been added to the list of proprietary products officially approved for the control of plant pests and diseases.

GROUP A: LEAD ARSENATE POWDERS

Boots' Arsenate of Lead Powder	Boots Pure Drug Co. Ltd.	**A 64**
Hemway Lead Arsenate Powder	Hemingway & Co. Ltd.	**A 66**
Summit Arsenate of Lead Powder	W. J. Craven & Co. Ltd.	**A 69**
Technical Products Ltd. Lead Arsenate	Technical Products Ltd.	**A 72**

GROUP B: LEAD ARSENATE PASTES

Boots' Arsenate of Lead Paste	Boots Pure Drug Co. Ltd.	**B 65**
Hemway Lead Arsenate Paste 15/16% As_2O_5 **Hemway Lead Arsenate Paste 20% As_2O_5**	Hemingway & Co. Ltd.	**B 67**
Hemway Colloidal Lead Arsenate	Hemingway & Co. Ltd.	**B 68**

GROUP C: LIME SULPHUR WASHES

Craven's Lime Sulphur	W. J. Craven & Co. Ltd.	**C 70**
Technical Products Ltd. Lime Sulphur	Technical Products Ltd.	**C 73**

GROUP D: MISCIBLE TAR OIL WINTER WASHES

Carbo-Craven	W. J. Craven & Co. Ltd.	**D 71**
Technical Products Ltd. Tar Oil Winter Wash (80% Miscible Type)	Technical Products Ltd.	**D 74**

GROUP E: STOCK EMULSION TAR OIL WINTER WASHES

Technical Products Ltd. Tar Oil Winter Wash (60% Stock Emulsion Type)	Technical Products Ltd.	**E 75**
Welspra S.E. Winter Wash	Welsh Navigation Steam Coal Co. Ltd.	**E 76**

There are no additions to be made to the list of approved organo-mercury dry seed dressings published in previous issues.

Applications for the approval of copper fungicides (exclusive of seed dressings), copper sulphate and products having rotenone-containing resins as the main active principle are under consideration.

It should be clearly understood that products in groups other than those named above have not yet become eligible for consideration under the scheme.

Ministry of Agriculture and Fisheries,
Plant Pathology Laboratory, Harpenden, Herts.

June 10, 1944.

NOTICES OF BOOKS

Inland Farm. R. M. Lockley. Witherby. 1943. 10*s.*

Inland Farm lies 400 ft. above sea-level at the head of a steep, wooded glen in the Precelly foothills which slope down to Cardigan Bay. When the author and his wife and family came to it from the neighbouring island of Skokholm in September, 1940, they found its 200 acres in the direst dereliction. Rabbits, bracken and thistles were the only competitors on land which had not seen a bag of lime for many years. The old Welsh manor house was no less neglected, but for all that they decided that the place had possibilities, and with the help of the invaluable "Baron" and the taciturn Welsh lad, Gwyn, order was gradually wrested from chaos. The little capital and meagre farming experience which Mr. Lockley possessed were counterbalanced by a keen determination to win through, and full use of the Agricultural Requisites Scheme. Over 100 acres were ploughed and cropped with oats, flax, kale and swedes; there might also have been potatoes had the seed not been diseased.

To set the coping stone to his success, Mr. Lockley has now taken over Island Farm as well, another derelict nearby of some 400 acres lying thinly on slate rock. This he hopes to farm on a co-operative basis, and we shall expect to read of his experiences and success in the third of an interesting and well-written trilogy.

Good Farming. (Teach Yourself Farming Series). V. C. Fishwick. English Universities Press. 1944. 3*s.*

"Good farming" is one of those expressions which implies much but describes little. In this book Mr. Fishwick of the South-Eastern Agricultural College, Wye, Kent, wishes it to be understood as "farming so carried out as to produce maximum economic output from the land". But there is more to it than that. The productive power of the soil must constantly be renewed, and this fact primarily determines the class of farming and the nature of arable rotations on the various types of land. No farming can be described as "good" which does not preserve, or even improve, the fertility of the land. The author has, however, set out very clearly and comprehensively the basic principles of British farming in all its diversities, and the book well fulfils its function as the key volume to six others in the *Teach Yourself Farming* series which the publishers have in preparation. How far it is possible for anyone to teach himself farming is a moot point: the average farmer has spent the better part of a lifetime farming and is still learning—from hard experience! But that is not to deprecate the value of this book. Newcomers to the industry and town workers who wish to take an intelligent interest in British farming need look no further for a first-rate introduction to the subject. Its 256 pages of text and drawings, together with a short glossary of technical terms and a useful index, make it extremely good value for money and a matter for congratulation to both author and publisher.

Cattle at the Crossroads. (Broadcast Discussions: *Farming Today* Series). Littlebury & Co., Worcester. 1944. 5*s.*

The series of discussions entitled *Cattle at the Crossroads*, which was broadcast in the latter part of 1943, and summarized in the December, 1943, January and February, 1944, issues of this Journal, aroused great interest and served to draw attention to livestock breeders' problems. Practical and successful breeders of cattle from different parts of the country, together with experts from Universities and Institutes, debated the various methods and systems of breeding and their application to present-day conditions.

The main problem for which a solution was sought was caused by the ploughing-up campaign and the priority nature of milk production dependent largely on home produced food. This amounted to almost a reversal of previous systems of livestock production, and certainly found the country short of good dairy bulls with officially-milk-recorded ancestry, and an insufficient supply of dairy cows. But beef cattle had also to be maintained. The situation could therefore be described as one in which we had an efficient beef cattle industry, a growing and efficient dairy industry, and in between a high proportion of farmers producing both milk and beef from the same animals.

The views expressed by the debaters were diverse and controversial, which is all to the good, since in that way thought is likely to be stimulated and further discussion provoked.

One question constantly recurred—should cattle be single- or dual-purpose? The answer is still awaited, but all cattle-breeders, whether pedigree or commercial, can profit by reading this book and forming their own conclusions, not only on this but on many other problems which are debated with knowledge and force. In short, the points made "over the air" can be recaptured by reading this excellent and suitably illustrated publication which preserves the discussions in their broadcast form.

NOTICES OF BOOKS

The Application of Electricity to Field Operations. C. A. CAMERON BROWN. British Electrical and Allied Industries Research Association. 1944. 6*s*.

As long ago as 1879, Chretien and Felix in France made a beginning in the application of electricity to farming operations in the field, when they introduced their 4 h.p. ploughing set. Since then interest has waxed and waned in several countries, notably France and Italy; New Zealand appears to have found a practical solution, and there have been rumours of experimental work in the U.S.S.R., but so far without reliable confirmation. Broadly, however, it can be said that electricity has made only an infinitesimal contribution to field operations in agriculture throughout the world; in Britain it has made no contribution at all. It is claimed in this booklet of sixteen pages that a successful application of electricity to even a small part of the agricultural field work of Great Britain would alter the whole aspect of rural electrification. This report, which is intended for the expert rather than the farmer, summarizes the available information on the various ways in which electricity has been applied to operate machines for ploughing, cultivating, harrowing, ridging, etc., examines the reasons why the system has so far failed of general adoption, and suggests lines upon which further research might be conducted.

The Countrygoer. 16, Heathcroft, London, N.W.11. 1944. 2*s*. 6*d*.

Before the war our countryside meant to the majority of townsmen little more than an "escape" from the turmoil of urban life and industry; the fundamental nature of the land, the essential character of the villages, and the paramount importance of preserving the traditional farming skill which was steadily being leached from the rural communities, were outside their consciousness. Few of the "countrygoers" in those days discovered more than the superficialities; for the most part, the real delights and the deep understanding which the countrylover knows were lost through ignorance.

A primrose by a river's brim
A yellow primrose was to him;
And it was nothing more.

Since then, however, town and country have become better acquainted in circumstances that demand clear vision and true perspective. That focus must be held; and it is publications such as this new series of *Countrygoer Books* which can help so powerfully. It is their aim primarily "to help the countrygoer to appreciate more keenly the pleasures of open air, the significance of the country scene, and the feelings of country people".

In the issue under review His Grace the Duke of Norfolk, the Rt. Hon. Tom Williams, M.P., Dr. C. E. M. Joad, L. F. Easterbrook, John Betjeman, Fred Kitchen and F. L. Stevens, are among the contributors. The many text illustrations and eight excellent half-tone reproductions add to the general attraction of a well-produced publication. Maintained at its initial high standard, this series cannot fail to promote that interest in country life which is the forerunner of rural prosperity.

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DEEP PLOUGHING AND GOOD CULTIVATION FOR BUMPER CROPS

J. CLAYTON

North Kelsey, Lincoln

WAR-TIME farming demands that the farmer shall produce all the food possible, not only for direct human consumption but for his live stock as well. Anything which increases this output should, therefore, be utilized to the full; it is a service to the community, and to the majority of farmers a great personal satisfaction. Although labour is scarce and artificials are rationed, there is no reason why cultivations should be rationed also. Much of our existing arable land could produce at least 25 per cent. more food if properly ploughed and cultivated. Only very few farmers (and those chiefly in the eastern counties) have discovered the enormous advantages to be derived from intensive cultivation for all farm crops.

Deep ploughing is possibly the most important operation: it assists drainage, and yet in a dry season conserves moisture; it gives an ideal tilth; and it destroys weeds. These combined will usually increase the yields of cereal crops by some 20 per cent., and root crops by even more.

Deep Ploughing Every Year Until very recently deep ploughing was practised only for root crops—every fourth year or so. Now, however, many farmers carry it out every year irrespective of the crop to be grown. Deep ploughing of old pasture is especially recommended, since the sward is put well out of the way and rots down during the season to form humus. Where the wireworm population is high, deep ploughing will often produce an excellent crop, simply because the wireworms are buried too deeply to do serious damage before the crop becomes well established.

Many thousands of acres have been ploughed no deeper than 4 or 5 in. for years on end, with the result that a hard pan is formed which prevents water draining through. If this pan is effectively broken up it is surprising how much better the fields drain and dry in readiness for spring cultivation. Personally I have been so greatly impressed by results that irrespective of the crop to be sown, three-quarters of this farm is deeply ploughed every year.

Possibilities of Weed Eradication Weeds are one of the greatest enemies of the farmer—greater perhaps than all the insect pests and diseases which attack his crops. Not only do they rob the seedlings of sunshine and air, but they starve the crop of the plant foods intended for its use. Thistles (the common creeping variety) can be eradicated by deep ploughing quicker than by any other method I know, particularly if it can be done in the summer or immediately the stubbles are cleared. On my own farm, if rain holds up harvesting operations I put all the tractors into the stubbles ; if there are no fields cleared, then ploughing goes on between the stooks. As an experiment I once left part of a field unploughed for several weeks ; where the ploughing had been done at harvest-time, hardly a thistle appeared during the following season, while the portion late ploughed was crowded with them. This particular field was barley after wheat, and although all of it received the same manurial treatment, the portion ploughed early carried far the better crop.

Twitch, or couch as it is called in some parts of the country, frequently infests cereal crops on light sandy soil. I have 100 acres of this class of land, and I have found the following method of dealing with it to be very successful.

A large single-furrow deep-digger type of plough is used ; this is fitted with a special attachment, made to our own design, and carries a very large skimmer at the back of the plough. Normally this plough is set to cut a furrow 12–13 in. deep, the skimmer following and turning the top 4 in. of twitch-infested soil into the bottom of the furrow. As the tractor proceeds on its next round, this rubbish is pressed firmly into the bottom by the furrow wheel of the tractor, and 8 or 10 in. of perfectly clean soil is brought to the top. This short, bunchy kind of twitch (*Agrostis*) cannot grow without air and will rot down during the season. It thus forms a very useful kind of humus. As this sort of twitch grows from seed, there will most likely be a full crop at harvest-time, but even so, none of it will be more than 2 or 3 in. from the surface. Ploughed down, this is an additional source of humus.

The long "bootlace" variety of twitch (*Triticum repens*) should not be ploughed in deeply, for it will either grow through or at least fail to rot ; if brought to the surface in three years' time it will still be alive. Although bindweed, coltsfoot, sow thistle, and other perennial weeds will not be

killed by deep ploughing, as is the creeping thistle, they will be greatly checked and in a very short time will disappear altogether.

Deep Discings Conserve Moisture Having insured, as far as possible, a good crop by this deep movement of the soil, we must think of deep and thorough cultivation before putting in a crop. For root crops, four or even six draggings or discings are not wasteful either of time or money. Many expert potato-growers do this, after which they ridge, split the rows or drag the bottom and then re-ridge. After planting, the field is either harrowed on the row top or dragged between the rows every week until the potatoes are ready for earthing up. It makes no difference whether there are any weeds or not ; it is the movement of the soil which counts to the potato-grower. Even in a very dry season continuous deep draggings will conserve moisture ; this is the farmer's way of supplying his own "rain". Some years ago in a very dry season a neighbour of mine scorned this idea, fearing to "let in the drought". For our part, we dragged deeper and more often. The results justified our faith ; we secured a good crop, while crops on undisturbed land wilted badly and cropped very much lighter.

No harm is done to the crop if the potatoes are harrowed after they are 6–8 in. high. Peas and cereals also benefit greatly from this operation ; if done twice each way a thin plant of wheat or barley will often produce a full crop.

Manures, either artificial or organic, cannot give of their best unless the soil is turned and moved to a good depth, to allow light and air to play their part. At the same time birds are given a good opportunity to pick up not only slugs, wireworms and other pests, but weed seeds as well.

PLOUGHING MATCHES

FRANK H. GARNER, M.A., M.Sc.

DURING the past two years Technical Development Committees have organized all kinds of demonstrations in their respective counties. Up to a point these demonstrations have been very successful ; they have attracted farmers, but they have not always catered for farm workers. In other words, there has been a tendency for one of the essential partners in the agricultural industry to be neglected.

Real Attraction to Farm Workers Ploughing matches, however, do cater for farm workers, and this is one very good reason why they form an important part of Technical Development work. Secondly, these matches have a far greater influence than might be expected, because the practice which competitors put in before the match tends to increase their general ploughing efficiency. This is all to the good for the industry because ploughing is the fundamental cultivation of the land ; if well done, all subsequent cultivations are made relatively easy. Thirdly, ploughing matches stimulate interest, with the result that they often led to discussion and argument. Finally, the ploughing

match appeals strongly to farm workers, as once there, they may be given the opportunity to see other demonstrations, such as plough-settng, the use of various farm machines, acetylene welding, vegatable production, methods of saving fuel, and so forth. Thus some description of the various ways in which ploughing matches may be organized and an indication of some of their most important features, may be of interest.

Matches to Cover Small Areas In these days, when petrol must not be wasted on unnecessary travel, it is not in the national interest to organize a match to cover a large area—say, one for a whole county: each should be limited to a single district or parish. In this way, competitors need travel only a short distance, and such short journeys make it possible for horses to walk to the match and be shown in competitions for the best plough pair, or the best turned-out horses. Another important subsidiary class may be for the best kept tractor.

Classes and Prizes The next consideration is the number of classes that should be arranged. Taking tractors first, the possibilities are: one class for ploughs to turn more than two furrows, a class for two-furrow ploughing by competitors over 21 years of age, and another for competitors under 21 years of age. Other classes could provide for land girls only and for members of Young Farmers' Clubs. With horse ploughing, corresponding classes can be arranged for single-furrow ploughs. The number of classes may influence the number of prizes that can be given, but all who have had experience of these matches will agree that it is undesirable for one person to win big money prizes; the greatest interest is aroused and the maximum satisfaction achieved when a relatively large number of competitors win prizes. In most classes a suitable first prize might be £3, with four or five other prizes if there are more than, say, eight competitors. Finally, experience suggests that special classes are worth while for those under 21, since it is most important to encourage the young worker to take to this skilled work.

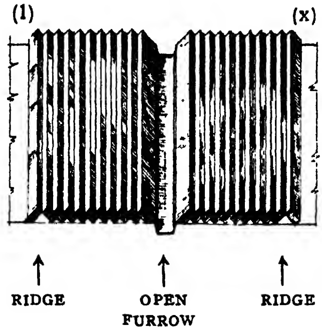
List Open as Long as Possible As regards the actual organizing of a ploughing match, it has been found that competitors usually prefer to withhold their names until the morning of the match. Certainly, by keeping the list open for as long as this the entries will be greater. The best plan is to announce that entries will be accepted up to a specified hour on the date of the match. Otherwise would-be entrants may arrive so late that judging and prize distribution will be delayed; in these circumstances competitors may already have left for home before prizes are distributed, especially if they have to take their horses any great distance.

It is essential, of course, to give adequate publicity to the match. Bills posted in public houses in the district where the prospective competitors live will unquestionably give the best results, but advertisements should also be inserted in the local Press to cover the widest possible field of interest.

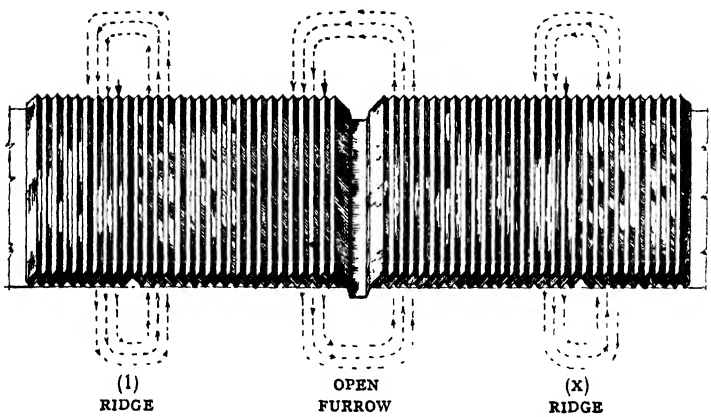
Choice of a Site The site of the match must be chosen carefully and should, if possible, be beside a main road, so that teams and competitors can find the venue easily and passers-by will be attracted by the event. No doubt the best test is obtained when grass

PLOUGHING MATCHES

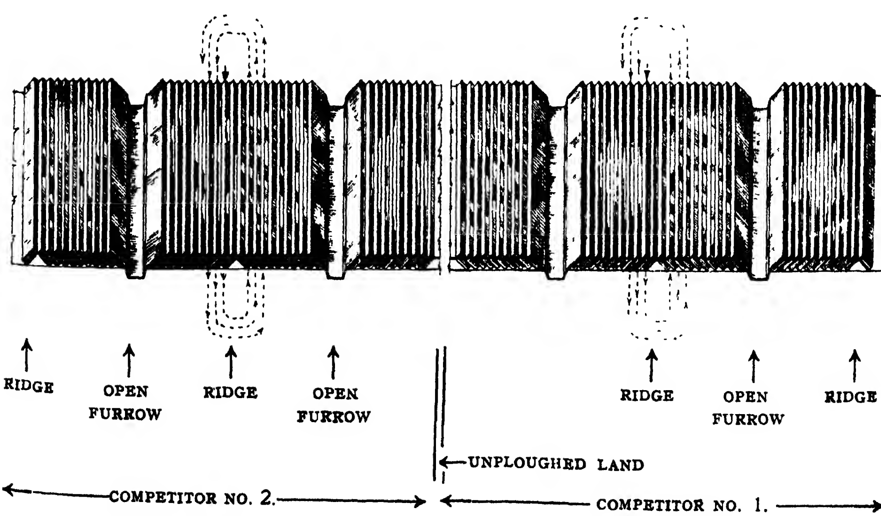
I



II



III



For explanation of diagrams, see p. 198.

is to be ploughed, because of the difficulty of burying the green turf. Alternatively, a stubble with plenty of self-sown corn will afford a good test. As a general rule, a surface that has been cultivated or harrowed after harvest is spoilt from the point of view of setting a test of good ploughing. If stubble is selected, the area to be ploughed should be so laid out that the drills of the stubble give no assistance to the competitors ; at the same time the ploughing should be square over the old plough furrows. The soil of the field to be chosen also warrants consideration : if the match is held in the autumn before there is much risk of rain to prevent ploughing, clay may be chosen, but from November to March lighter soil is probably better, in case a wet day causes postponement and endless bother.

Marking Out Before marking out the land, it is important to consider the various systems that may be adopted. These are shown in the diagrams on p. 197. With Diagram I, it is necessary to make one ridge at the right of the field when marking it out For the match, competitor No. 1 will open his top marked (1) and then move to the space (1) to (X), and plough that area by splitting or cutting to produce an open furrow midway between (1) and (X). Similarly, competitor No. 2 will make his ridge at site (2) and "split" his land between ridge (2) and (1).

With Diagram II, when marking out it is necessary to lay a ridge at the right of the field, and then to plough round the ridge five times. On the day of the competition No. 1 will make his ridge and plough round it five times. He will then move to his right and split or plough the site between (1) and (X), leaving an open furrow in the centre of this work. This has the disadvantage that if (X)'s ploughing is bad it may result in the land being left badly for (1), but the judges will make allowances for such conditions—they will be quite obvious.

With Diagram III, it will be noticed that each competitor makes three ridges and two open furrows, making what is known as a "land" or "stetch". In this case, no competitor does any ploughing adjacent to another, but there is a portion of unploughed land between each competitor—see the diagram. From the point of view of the ploughing match, this system is considered to be the best, but from the viewpoint of the farmer on whose land the match is held there will be many unploughed strips of land needing attention afterwards.

These lay-outs are equally suitable for tractor or horse work, but it will be necessary to modify measurements according to the power used, and whether two or more furrows are being turned with the tractor ploughing.

The Test An adequate test can usually be carried out in two hours, so that the actual area needed for each competitor ploughing with horses is about one-eighth of an acre (this allows for loss of time, adjustments and also for judges to inspect the work), while with tractors ploughing two furrows, the area required is one-sixth of an acre. As far as possible, the length should be 60 or 70 yd., and the width can be modified accordingly. The length is marked out by drawing a furrow at each end to produce a headland, and the end of each ridge site must be marked with firm, numbered stakes, measured out very carefully. The headlands must allow sufficient room for turning without providing an excess ; 8 yd. for horses and 10 yd. for tractors have proved satisfactory.

The competitors must be given careful instructions by stewards before they commence work, for driving to the wrong stakes may lead to various complications. Two stewards are needed for each class competing at one time. The depth of working must be defined; generally conditions should allow of 6 in. for horse ploughing and 7 in. for tractors. Some judges may request competitors to stop at certain stages for their work to be inspected; for example, after they have laid the two furrows for the top or ridge. Some judges merely inspect the work after it has been completed before deciding on the winner, but others prefer to judge throughout the ploughing, using a score card similar to that shown below:

SPECIMEN SCORE CARD FOR PLOUGHING MATCHES

Name	No.	Opening	Straightness	Uniformity	Burial of material	All ground ploughed	Misc.	Closing	Total	Prize
		Max. 100	*Max.* 50	*Max.* 50	*Max.* 50	*Max.* 50	*Max.* 100	*Max.* 100	*Max.* 500	

With all these arrangements completed, only fine weather and plenty of competitors are needed for a successful day. The recommendations made above have worked well in the writer's experience and usually prove satisfactory for a first-class match.

INTENSIVE LARGE-SCALE FARMING IN THE ISLE OF WIGHT

A. E. BROWN

Merston Manor, Isle of Wight

MERSTON MANOR itself was farmed by my family from 1720 to 1871, when it was sold. It was purchased by me in 1928 and since then the area farmed has been steadily expanded to its present size of 2,200 acres. About half of this I own; the remainder is rented. It includes land in various parts of the Island—south, east and centre—and a small nursery near Ryde. Naturally an undertaking of this size requires a great deal of administration, and to provide this central offices have been established in the market town of Newport. The staff consists of the Secretary, Office Manager, a Transport and Sales Manager, and three clerks.

Thirteen Farms on a Wide Range of Soils There are thirteen farms in all, run under a general manager, with farm foremen and under-foremen, the total staff comprising some 300 employees. The farms are roughly in three blocks: that near the centre of the Island, around Merston Manor, consists of about 900 acres; that near the south coast of about 700 acres; and that in the east of about 650 acres. Two small dairies, totalling some 60 cows, are kept at Merston Manor and Pagham. There are also two herds of Wessex pigs. Before the war a Large White cross was favoured, and all the pigs from 40 sows were fed for bacon, but owing to war-time feeding difficulties, the pigs are now sold at the weaning stage (about 8 weeks old). For many years several thousand laying hens were kept on intensive lines, incubators and electrically heated brooders being used for rearing. Here again, as a result of the war, the stock has been reduced to a minimum.

As will be imagined, these thirteen farms cover a diversity of soils. For the most part, however, they are on the upper and lower greensands, with some chalk on the higher and some clay on the lower lands. The greensand varies from deep loam to light blowing sand.

As much of the land as possible is under the plough. Where this is impracticable, as on very steep hills or low-lying moors, the land is used for grazing. About 150 cattle are kept, which are wintered in yards or stalls and tread in some of the surplus straw.

Cultivating on Hilly Land The hilly nature of most of the farms presents a problem unknown to those more fortunate growers in many market-gardening districts where so much of the land is dead level. Of the twenty or so tractors used, at least half are crawlers, and these are the only means of efficiently cultivating the steep gradients. The tractors vary in size from the midget M.G.2 to the powerful International Diesel T.D.9. Deep ploughing is considered essential; a depth of 12–14 in. is generally possible and, I believe, is preferable to subsoiling. Contrary to popular opinion, deep ploughing is not found to be injurious for wheat and barley. At any rate, an average of 15 sacks of wheat per acre on 120 acres has been obtained—a fact which can speak for itself.

Although tractors are depended upon for all the heavier work, about 20 horses are kept, which are still found to be valuable for the lighter haulage jobs and cultivations.

Cropping and Marketing The system of cropping is based largely upon the potato acreage—700 to 800 acres, including about 200 acres of earlies. Before the war sugar beet was also grown extensively, being sent by sea in 600-ton vessels to Selby, but in 1940 cultivation of this crop on the Island was suspended until after the war in

view of the need of transport for other purposes. The acreage previously occupied by beet is now mainly under potatoes.

A typical year's cropping (*in acres*) is:

Ordinary Farm Crops

Wheat 130 Barley 85 Oats 40

Forage Crops

Seeds Hay 30 Field Beans 10 Mangolds, Kale, etc. 15

Potatoes and Market-garden Crops

Potatoes	800	Broccoli	80	Lettuce	20
Cabbage (Spring)	100	Broad Beans ..	15	Cucumbers ..	12
,, (Summer)	60	Runner Beans ..	15	Radish	5
,, (Green)	100	Peas	25	Rhubarb ..	5
,, (Savoy)	150	Parsnips	50	Tomatoes (Outdoor)	20
Carrots	50	Beetroot ..	50	Leeks	10
Brussels Sprouts	50	Onions	50	Swedes and Turnips	30
Cauliflower ..	20	Marrows	12	Sundries	20

The disposal of the produce is a business in itself, and a fleet of five heavy lorries and several smaller vehicles are kept busy hauling produce from, or requisites to, the farms. Outside haulage is also employed on a large scale.

Considerable quantities of produce are marketed all over the Island to serve its 90,000 inhabitants, but substantially heavier tonnages are shipped to the mainland for the South Coast, London and other markets. Shipping is, of course, a handicap; there are inevitable delays, and the extra handling involved in loading and unloading the vessels militates against the produce arriving at the market in as fresh a condition as when it leaves the farm.

Artificials Maintain Fertility

As previously stated, about 150 cattle are wintered either in yards or sheds. This yarding, however, is not practised primarily for the purpose of obtaining supplies of farmyard manure, since I do not hold the popular belief that fertilizers of organic origin are necessary as plant food. In my view such belief is biologically unsound: plants take up minerals, not organic substances, and the plant is Nature's agent for converting the minerals into the organic material which is necessary to sustain animal life. Moreover, whether fertilizers are applied as organic or inorganic substances, they have to be converted into mineral compounds before they become available as plant food. It is the mineral element on which the plant lives, and this being so, it is a little difficult to follow the arguments of those who seek to show that healthier crops are grown with dung than with fertilizers. As Sir E. John Russell said a year ago in his address to the Society of Chemical Industries at Liverpool: "From time to time there has been much discussion on the question whether organic or inorganic sources of plant nutrients are best. It seems strange that in this twentieth century there should still be people who think that ammonia derived from organic matter differs in some subtle way from ammonia derived from gas liquor or produced synthetically. I know of no evidence that organic manures produce healthier or more nutritive crops than inorganic fertilizers".

For the building up and maintenance of fertility, therefore, we here depend almost entirely upon purchased inorganic fertilizers.

And what about humus? Well, several hundreds of acres of the land now under crop have, by clearing and draining during the last twenty years, been brought under profitable cultivation. Under previous occupiers they had been allowed to revert to barren heath, gorse, bracken, bog and copse. Long experience has shown that provided good crops are consistently grown, the humus content of the soil can very well be left to take care of itself. For instance, last year a humus test was taken on two fields of 50 acres which deliberately had been given nothing but inorganic fertilizers since 1928. The humus content was found to be 33⅓ per cent. above the average for that class of land. This land had been farmed by the previous owner on the four-course system with folding sheep, but neither the fertility nor the humus content was abnormally high.

STRAW SLUDGE: HAMPSHIRE EXPERIMENTS

F. H. Ransome

Hampshire War Agricultural Executive Committee

In the spring of 1943 the Agricultural Improvement Council directed attention to the possibility of composting surplus straw with the products of sewage disposal plants. The aim is to obtain a manure which can be returned to the land with profit, and to supply a certain amount of plant food and rotted organic material which is highly valued by market-gardeners and farmers. From the sewage disposal point of view, the pressure on overloaded plant is relieved, and the usefulness of sludge as a manure possibly improved.

With the co-operation of certain local authorities, a number of experimental heaps were laid down in Hampshire. They were of various sizes: and made with various proportions of sludge and straw in layers. From experience gained in this way, the following conclusions have been drawn

1. Complete soaking of the straw is essential;
2. An adequate amount of nitrogenous material must be mixed with it;
3. The heaps must be aerated.

In brief, as with other forms of composting, the three essentials are water, nitrogen and air.

Method I: Using Dried Sludge The heap may be of any convenient length, with a width of 9 ft. Drain-pipes are laid on the ground in rows across the site of the heap at intervals of 2 ft. 6 in. A layer of straw, not more than 18 in. thick, is placed on the pipes; a layer of dried sludge 2 in. thick is spread over the straw, which is then wetted with water or sewage effluent by means of an engine-driven pump. Another 18 in. of straw and 2 in. of sewage are added, and so on until the heap is approximately 6 ft. high. Each layer should be wetted as it is added to the heap and the whole should be soaked evenly until the liquor runs out at the base.

In heaps of this type a temperature of up to 160° F. was developed within five days. In hot weather the heap dries out and a further soaking must be given as necessary. Following the second soaking, the temperature rises rapidly again and is maintained for a period of about three weeks, after which it gradually drops. If the job is done properly, after three months the straw will have rotted and the dry sludge will have been broken down. It is considered probable that the grease content of the sludge is broken down as methane is given off.

Four tons of straw and eight tons of dried sludge produce approximately 24 tons of manure. The labour cost of making the heap and wheeling dried sludge from the drying beds along a 5-yd. roadway to the heap was approximately 5s. per ton.

Method II: Using Liquid Sludge Heaps 9 ft. wide and 24 ft. long were laid down over drain-pipes as in Method I. Each 18 in. of straw was treated with settled primary sedimentation sludge containing about 6 per cent. solids. A plank is placed on the heaps for a man to walk on, thus preventing too great compaction. (Bales of straw at the sides of the heap may be used for this purpose.) As with Method 1, the layering is continued until a height of about 6 ft. is reached. After a few days a rise in temperature to 160° F. is obtained, and at the end of three months a fairly well-rotted material results, especially at the top and edges of the heaps. The centres of the heaps have been found to lack air. In practice, the amount of liquor applied per ton of straw in this method is approximately 1,200 gallons. Straw will only absorb four times its own weight of water—that is 800 gallons per ton. In consequence, the straw has acted as a filter, but at the same time excessive soaking has occurred, and this accounts for the difficulty of getting air through the middle of the heap. Turning such heaps any time after one month from completion results is another rapid rise in temperature and, in the experiment, complete rotting took place within two months from turning.

The heaps on a base 9 ft. × 24 ft. took four tons of straw and 4,800 gallons of effluent, and produced, after three months, 20–25 tons of manure. In one plant, designed some years ago to serve a population of 10,000 but now serving 16,000, the direction of 50 per cent. of the town's sludge on to the straw has relieved the digestion tanks and allowed the process to be completed in the normal manner. The small amount of labour involved in erecting the heaps and soaking them has, of course, resulted in less dried sludge being produced and in giving it time to dry out. In turn, this makes for much easier handling on the drying beds, and the small staff at these works have found the composting a help rather than a source of extra work.

The Heaps It is important that the heaps should be built quickly; not more than three or four days elapsing from the beginning to the end of the process. If a layer or two is added, say, once a week, the bacteria causing the rise in temperature do not have a chance to get into full action.

Where convenient, the heaps may be built within a frame made of straw bales. These can be used again for the same purpose, or the wires can be cut and the partially wet straw used in the construction of other heaps.

STRAW SLUDGE: HAMPSHIRE EXPERIMENTS

Sludge and Straw The sludge at the bottom of the primary sedimentation tank is let back to the pump-house. It is then pumped through a 6-in. pipe to the digestion tank. This pipe is tapped and, by means of a length of old fire hose, the liquor is directed on to the layers of straw. It should be noted that if the elementary rules for the making of the heaps are observed, and sufficient aeration is allowed for, any smell from the sewage disappears within half an hour of its application to the straw. There would seem to be nothing in the process to prevent such heaps being made on the outskirts of inhabited areas.

Some local Councils have found it satisfactory to purchase straw at about 65s. per ton. Each ton of straw makes approximately 5 tons of manure, using the liquid method, at a net cost of 13s. per ton. Some Councils are having straw brought to the sewage works by farmers who, three months later, when bringing more straw, take back the finished product as manure. It is found that Councils generally are content simply to cover their net costs and overheads.

The Manure The appearance of the resulting compost is very much like that of farmyard manure, and its chemical analysis closely approximates to that of a well-rotted sample, except that it has a considerably higher nitrogen content and a lower potash content. There is no difficulty in disposing of it to market-gardeners; in fact, there is a demand for many thousands of tons beyond the quantity we have so far been able to produce.

Haulage may raise a problem, but in our own experience we have been fortunate in obtaining what we required.

There are many tons of straw surplus to farmers' requirements and there is an ample supply of sewage not being fully utilized. On the other hand, there are many thousands of acres of land known to be short of humus, and the methods of composting are clearly established and present no practical difficulties. Supply and demand should therefore be brought together, especially where straw supplies are near to a sewage plant.

SAMPLING OF LOW-GRADE FERTILIZERS

In the June issue of this JOURNAL (pp. 141–2) it was stated that where quality of the fertilizer supplied is in doubt, the purchaser should send a sample to the Official Sampler appointed by his County (or County Borough) Council. The proper procedure, however, is for the purchaser to *call in* an Official Sampler, who will take a sample for analysis in the manner prescribed under the Fertilisers and Feeding Stuffs Act, 1926. This should be done within 14 days of the delivery of the consignment or of the receipt by the purchaser of the statutory statement or warranty, whichever date may be the later. No fee (or only a nominal fee) is charged.

Purchasers of any fertilizer or feedingstuff scheduled under the Act, or of any non-scheduled article in respect of which a warranty, expressed or implied, has been given by the seller, are entitled to have a sample so taken and to receive a copy of the analyst's certificate. If the analysis discloses a deficiency or breach of warranty, the purchaser will thus be in a position to make a claim on his supplier. Applications for the services of an Official Sampler should be made to the Clerk of the County (or County Borough) Council.

IMPRESSIONS OF CANADIAN AGRICULTURE

T. B. Manson

Department of Agriculture for Scotland

Mr. Manson was one of a small party of agriculturists who visited Canada last year at the invitation of the Canadian Government.—*Ed.*

ALTHOUGH the Dominion of Canada is slightly larger than the United States, its population, some 11½ millions, is only about 8 per cent. of that country's—and for the most part it is confined to the coastal provinces. Its agriculture is contained in a huge basin bordered on the east by the Appalachians and the Laurentian plateau, and on the west by the Rockies.

The Coastal Provinces Conditions in the coastal regions are not greatly unlike those of the United Kingdom. The rivers, mountains, hills and valleys, the grass fields, the dairy cattle, and the forage crops, seem familiar to a visitor from Britain. A journey along the banks of the St. John River in New Brunswick, for example, readily awakens memories of Dumfriesshire and Galloway. Sufficient rain falls to enable agricultural operations and cultivations similar to those of Britain to be conducted, but even here, close to the seaboard, the winters are severe and the summers hotter than we experience.

In the eastern coastal districts, including Quebec and Ontario, dairy farming is much in evidence. There is little difficulty in maintaining a good sward of grass, hay is grown and secured with ease, and oats produce a reasonable crop. Only with turnips are difficulties experienced, for the growing season is short and the intense summer heat is not conducive to growth. It is calculated that there are only 105 days available for potato growth. The silage crop, however, is firmly established, and the protein content of alfalfa hay and timothy and clover is high. There is therefore little difficulty in maintaining herds both in winter and summer. Of the total milk production of Canada, nearly 70 per cent. is produced in the maritime area of Quebec and Ontario. The Canadian is normally a great milk drinker, and it is estimated that the *per capita* consumption of milk per day is nearly one pint. At the present time much of the milk is converted into cheese or dried powder for export to Britain, where they have played an invaluable part in our war-time dietary. (In 1943 the Canadian Government contracted to send 125 million lb. of cheese to this country.)

Of importance also in the eastern districts is the fruit of Nova Scotia, the potatoes of New Brunswick, the tobacco of Southern Ontario and, increasingly, the soya bean. During the war there has also been a marked extension of the acreage devoted to sugar beet, and peas and beans for canning.

In the western province of British Columbia the climate is highly congenial. Dairying flourishes and there is a considerable acreage in market-gardens. The Okanagan Valley is the centre of a prosperous fruit-growing area, farmed largely on a co-operative basis, and the produce is of outstanding quality.

The Prairie Travelling westwards, the first dissimilarity to our own conditions is noticed in Northern Ontario, where a bleak area of unweathered soil and rock stretches to the edge of the prairie on the border of Manitoba. Thence the prairie sweeps through Manitoba into

Saskatchewan and Alberta to the foothills of the Rockies. This area, which has made Canada world famous for its wheat, was originally the bottom of the great inland lake of Agassiz. It is a vast expanse, practically unwooded, and has an average rainfall of not more than 10–15 in. a year. The cultivated area in these provinces accounts for about 70 per cent. of the total area under cultivation in Canada. The dry conditions and the short, intense summer produce a hard grain which commands top world price. War conditions have necessitated a considerable reduction in the area devoted to the crop, but the 1942 harvest yielded 607 million bushels; at the end of March this year, it was estimated that the total stocks of Canadian wheat amounted to 545 million bushels, although war-time policy has made it necessary to switch over to coarse grains for the maintenance of the increasing head of live stock.

Winnipeg occupies pride of place on the prairie as one of the greatest grain exchanges in the world, but Edmonton, in Alberta, is gaining importance with the development of the Alaska Highway.

Dry Land Farming The fear of drought is ever present in the mind of the prairie farmer. In 1937, the last year of a bad period, the total crop was reduced to 180 million bushels. Even including the high figure for 1942 (607 million bushels), the average over the previous decade for the whole Dominion is in the neighbourhood of 13 bushels per acre. Wheat is essentially a dry land plant: no other cereal can so well withstand a lack of moisture. On the other hand, live stock must have water, and this is a factor which needs to be remembered by advocates of mixed farming on the prairie.

The dry conditions necessarily impose modifications in methods of cultivation. The prairie farmer dare not aim at the tilth commonly obtained in Britain—that way would lie erosion. Indeed, the erosion problem in Canada is just as serious as it is, say, in Oklahoma in the United States, with the difference that Oklahoma is not frozen up for months in the winter. The Canadian farmer is grateful for the winter, since, lacking rivers, the winter snow can be trapped when it thaws. In this arid area, therefore, the farmer has so to conduct his tillage operations as to preserve a cover for loose soil. Normally on the prairie wheat alternates with a bare fallow. When the crop has been harvested the stubble is left over winter, and after the thaw in the drier districts the fallow is worked with sub-surface cutting implements to prevent weed growth, leaving the stubble roots holding the soil particles together. The maintenance of this "trash" cover is supremely important.

Strip Farming Strip farming is also being practised increasingly to limit the effects of wind erosion. This involves cropping and fallowing the land in alternate, long narrow strips rather than in blocks.

This strip farming is also important to check insect pests and fungus diseases, against which a ceaseless war is waged. The larvae of the deadly wheat stem sawfly, for example, seek a home in the hollow stems of the wheat, and it is not unknown for crops to be 100 per cent. affected. Sowing in strips and the use of bait crops limit the severity of the attack. Research workers, particularly at the Rust Laboratory in Winnipeg, are evolving solid-stemmed wheats to combat the ravages of this pest. The same laboratory has identified 200 different varieties of rusts and raised many new rust-resistant wheats.

Water Conservation Sufficient has been said to indicate the importance of water on the prairie, and the Federal Government, following a lead by Alberta, constituted the Prairie Farm Rehabilitation Association in 1935. The function of this Association is to encourage the formation of Agricultural Improvement Associations to disseminate advice on the latest conservation practices and directly to foster and create land improvement on a large scale. It is estimated that over the 16 million acres of prairie 12 in. of rain falls annually. The land known to be irrigable extends to 4 million acres, yet only half-a-million acres have so far been irrigated. The parent Association encourages and creates water-traps, ranging from simple dug-outs to elaborate reservoirs, in an effort to catch the spring thaw of the snow and to hold the water for future use. In addition, land which has been shown to be unsuitable for cultivation is "retired" and put down to grass. These community pastures, sometimes embracing large acreages, are normally watered and ring-fenced, and the Government supply good sires for stock improvement. Water is the limiting factor in grazing, and it is customary to calculate not more than an average of one steer to 20 acres.

It is not easy to establish timber on the prairie, but there is an obvious need of shelter belts and snow traps, and the P.F.R.A. has supplied millions of trees for this purpose. The blessings of irrigation are spreading to a growing number of communities. Even the flourishing fruit area of the Okanagan, in British Columbia, is entirely dependent on irrigation.

Live Stock Mention has already been made of the importance of dairying in the coastal district, but obviously in such a huge country there is bound to be dairying to a varying extent over the whole prairie, according to the needs of the population.

While there has been a considerable increase in dairy produce, the remarkable expansion of the pig industry during this war is the most noteworthy feature in livestock farming. The number of pigs on farms is now over nine millions. Canada has supplied 85 per cent. of the bacon requirements of the United Kingdom during the last few years: for the first three months of this year inspected pig slaughterings totalled more than 2,800,000. All the carcasses sent to this country are most carefully graded, and there is a real attempt to meet the requirements of the British housewife. In this connexion it should be noted that to meet bulk requirements the Canadian producer was forced to feed his pigs to heavier weights in 1943, with consequent sacrifice of quality.

There has also been a significant increase in the pig population of the prairie provinces, which is all to the good as a partial application of mixed husbandry. Promising efforts are being made to increase sheep stocks, and there has also been a marked increase in the number of hens and chickens.

Potentialities In this brief survey it has been impossible to cover the whole ground, but it will have failed in its purpose if it does not convey to readers that this great land surface, intersected by too few rivers, is rather sparsely populated by indomitable folk who are patiently and courageously evolving a technique to counter certain natural disadvantages. Mistakes there have been, but they are recognized and being rectified. The agricultural development of the Dominion is a subject for considered planning. The technicians are there with the knowledge, the vision and the necessary enthusiasm. Increasingly, by the establishment of Provincial and Dominion research, by the creation of experimental farms

and by field days, education is effectively spreading to all regions. There may be setbacks—especially in dry land farming, where distances from consuming centres are great—but science marches on, and distance can be nullified by the adoption of modern methods of refrigeration and transportation. The war effort of this great Dominion has shown a potentiality in expansion that augurs well provided there is economic security.

Big Increase in Farm Live Stock (*Editorial Note*) The latest official survey of live stock on Canadian farms shows substantial increases in all classes of live stock. The number of cattle on farms is placed at 9,506,200, showing an increase of 672,500 head, or 7.6 per cent. over the 1942 figure. The increase was common to all provinces, although there was little change in Ontario. Saskatchewan had the highest increase with a percentage of 18.3 over 1942. The number of milk cows in Canada increased by 120,600, relatively small increases occurring in all the provinces. Altogether there were 3,953,000 milk cows on Canadian farms, at December 1, 1943.

Following the tendency of increased numbers during the past years sheep at 2,733,000 head increased by 250,300, or 10.1 per cent. on the number in 1942, in all provinces except British Columbia. The increase of 127.8 per cent. in Saskatchewan was particularly marked. The 1943 flocks include a high proportion of breeding stock, an indication that the increase may continue during 1944.

The number of hogs on farms in 1943 reached 9,473,000 head, an all-time record—an increase of 1,723,000 or 22 per cent. over the corresponding date in 1942. The increase was common to all provinces except Ontario, and was particularly marked in the three Prairie Provinces.

In the number of hens and chickens (57,512,500) there was a sharp increase of 7,731,200 birds. This represents an extension of 15.5 per cent. on the number in 1942. The increase in the provinces of Saskatchewan and Nova Scotia exceeded 20 per cent., and in all the other provinces the increase was greater than 10 per cent. Turkeys numbered 3,077,300, an increase of 36,800, which was confined to the provinces of Prince Edward Island, Saskatchewan and Alberta.

LEY FARMING CONFERENCES

DURING March of this year, six one-day regional conferences were arranged for the purpose of discussing the general problems of ley farming, of pooling knowledge within regions of comparable farming conditions and of clarifying views in relation to the utilization of leys—their place in the rotation and their development in relation to livestock policy. Every War Agricultural Executive Committee was invited to send two representatives to one of the selected centres, and in most cases the Executive Officer and either the Chief Technical Officer or the Grassland Officer attended.

Those points in most general agreement are set out below.

Definition . The term "ley farming" is defined as a distinctive practice, and should be applied only to a system which provides rotational grass in the form of leys of two or more years' duration. It must not be confused with direct reseeding, the cultivation of lucerne, or the one year

"seeds" of normal rotations. Publicity has tended to emphasize the "ley" rather than the "farming" and to overlook the fact that the creation of leys is not in itself the goal at which the system aims. The main objective is the maintenance of a high tillage output with an increased stock-carrying capacity. This can be achieved only where the new method fits in with the general economy, the planned rotation, and the livestock policy of the farm. Indeed, it is the stock rather than the ley that is the important feature, and any wide adoption of the system can take place only in the light of a stable future for livestock production.

The need for planning cannot be over-emphasized. Leys can be produced more quickly than stock to graze them; they must not be made merely to enhance the beauty of the landscape or to satisfy the exuberance of the system's apostles.

Utilization To obtain the maximum advantage of ley farming more cattle and sheep of the right types must be provided. There is need for more careful breeding and crossing, especially among sheep. By reason of its heavy demand on labour, it seems unlikely that the arable flock will return to its former proud position and must therefore be replaced largely by grass sheep. Cattle-rearing must become more efficient and more profitable. It must be able to compete with the more attractive returns from milk-selling and so prevent any further undesirable mixing of breeds.

General adoption of ley farming cannot be recommended. In good arable areas capable of producing profitable crops for human consumption, nothing more than a one year seeds mixture is desirable. In stock areas, and on thin soils in areas of moderate or high rainfall, leys can be of the utmost value, but they must be established as a succession of fields, for one isolated ley is of little use to any farm. In all cases, and especially on heavy land, it is essential to retain some old pasture for winter grazing and for those undefinable virtues which old grass possesses.

The exact position which the leys will occupy as producers of stock food must be carefully considered in every farm plan. They are at their best in the early part of the year and are especially suitable for young stock, but after July old grass is generally superior in feeding value. Provision must be made for hay and rotational fodder crops to supply winter needs.

Capital must also be available for the provision of stock, buildings, fencing and water.

Establishment The land must be clean and in good heart. The seedbed must be thoroughly prepared and well consolidated. Early sowing is generally favoured and many different methods are used, but no one system seems worthy of special recommendation.

Barley remains the most popular cover crop, but is less suitable than the other cereals. On rich soils where cover crops may be undesirable, or in areas of low summer rainfall when good "takes" are uncertain, sowing may, with advantage, be carried out early in the autumn.

There is still room for simplifying general seeds mixtures and for a reduction in their price. Commercial strains are thoroughly satisfactory for short leys but a mixture containing Aberystwyth strains, with their higher degree of persistence and leafiness, is to be recommended for long leys. Special mixtures are required for light soils in areas of low rainfall.

Management Successful management calls for great skill and knowledge. Only good judgment and good stock can make full use of a good ley. Mixed grazing is to be preferred, and sufficient numbers of both cattle and sheep must be available to enable proper grazing to be carried out on a rotational basis. Grazing in the first year is generally desirable, but in some circumstances hay, especially if made early, may be more suitable and of greater economic value. In the early part of the year when the growth is young and succulent, access to dry fodder will prevent digestive troubles such as "blowing".

Leys should be ploughed up at their optimum stage of growth, and either beans or potatoes will offer a more successful and profitable crop to follow than the traditional wheat.

The conference decided that further and more precise investigations were required on the following points:

The economics of a full system of ley farming.
More efficient and profitable methods of calf-rearing.
The true evaluation of herbage.
Methods and value of early haymaking.
Improvement and extension of seed production.
Improvement of varieties or strains of lucerne and sainfoin.
Methods of drilling grass seeds; types of drills.
New forms of portable fencing.
Legal problems of tenant right and agreements.

OUR YOUNG FARMERS MAKE SILAGE

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and

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THE National Silage Contest organized by the National Federation of Young Farmers' Clubs last year has afforded the writers, who acted as judges, a good opportunity of reviewing the difficulties commonly encountered in making silage and of ascertaining popular opinion of the process as it affects farm organization and the animal food supply. The practice of ensilage has had a chequered career in this country; the progress achieved in sporadic bursts of enthusiasm has subsequently been lost in years of comparative indifference. Interest in the process depends upon the comparative advantages and comparative costs of other methods of conserving food for winter feeding of live stock.

Silage-making as part of the Farming System Silage-making involves heavy work, absorbs a good deal of labour, and requires considerable attention to detail if waste is to be eliminated. Labour and waste are the real stumbling blocks to greater headway, but there is a more subtle factor to consider. Silage is still regarded by many farmers as a substitute for hay or as a by-product of the farm. The art of haymaking is generally well understood, though even with this age-old practice there is considerable room for improvement

in the quality of the product. When silage is regarded purely as a by-product the labour and trouble involved are commonly considered to be too great to make the effort worth while. It is held to be far simpler to graze surplus grass or try to make it into hay, even though the odds are against it being successful. Few farmers plan to make ensilage a part of the farming system, and fewer still treat a silage crop with the same care that they give to potatoes, wheat or kale.

All these points were clearly demonstrated in the contest, and a review of the final results may help to reassure those who still hesitate to make silage. The first four area prizewinners were, in order of merit, Farringdon Gurney (Somerset), Newbiggin (Durham), Dauntsey's School and District (Wiltshire), and Felinfach (Cardiganshire).

Waste-free Silage That silage can be made without waste was ably shown by the first three winners in the National Contest. The Newbiggin Club, for instance, achieved success at its first attempt. The silo used was of the wire and paper type—admittedly the most difficult to erect and fill, yet it contained practically no waste. The paper lining was unperforated, the soil seal efficient, and a good thatch had kept out all rain water. The first essential of any silo is that it should be airtight and watertight. If the structure is taken down and used for filling a second time in one season, side waste is inevitable ; this happened in the case of the Farringdon Gurney Club, which otherwise made an excellent show. Under such conditions the side waste can be very considerable ; it is more economical to have two silos than try to use the same one twice in the season.

Efficient Labour Organization One cannot deny that silage-making is hard work, because the water content of the crop is high. There is thus more carting than with hay, and the ground is cleared less rapidly when the crop is ready to lead. It should not be forgotten, however, that the crop is handled only once, that the farmer is largely independent of weather conditions, and that if the crop were cut for hay at the same stage necessary to make high quality silage, the venture would be hazardous unless salt were used. Equipment to reduce the labour requirement for silage-making is receiving a good deal of attention ; the winning club used the Hosier pick-up to good effect. This club was efficiently organized, and its salient feature was smooth and continuous working, governed by the temperature rise of the mass. The silo was sealed and thatched as soon as filling was completed—an important point, since failure to make good silage without waste is frequently attributable to the postponement of sealing until some "more convenient" time. Before then, rain may have fallen and probably caused some spoilage.

Silage Crop is as Important as any Other Another point clearly illustrated in the competition is the manner in which other farm operations tend to take precedence over, or interfere with, silage-making. This should not be. Ensilage offers a means of preserving valuable food in a succulent form for use in the winter, and as such it should not be subordinated to any other consideration. All the time that the crop is waiting to be cut, growth continues and the young material of high protein content becomes increasingly fibrous and stemmy, so that the silage ultimately made from it is of much

lower feeding value. In place of a food that can be fed at the rate of 20 lb. per gallon of milk, one has a product comparable only with moderate quality hay. In the writers' opinion, it is sheer waste of time, effort and molasses to use old crops for silage unless the weather is adverse and ensilage is the only means of saving the crop. Stack silage is probably the simplest way of tackling this problem.

Silage from Lawn Grass The potentialities of short grass from lawns and playing fields as a source of highly nutritious feedingstuff were fully exploited by Dauntsey's School, where a season's mowings from the cricket field were converted into excellent silage, uniform in quality, virtually free from waste, and of high feeding value. Great care is necessary in dealing with short material of this nature, and the difficulties are enhanced when the supply is spread over a long period. Yet this entry showed no stratification (which denotes perfect control of temperature) and there was no tendency to a butyric type of fermentation. Once more the result showed that provided the technique of ensilage is strictly followed, the product will be of high value and that previous experience is not essential, though doubtless an advantage, to produce a first-class product.

"Let's Tackle the Job Properly" In judging this competition, factors other than technical efficiency were taken into account, such as co-operation between members of a club, organization of labour, the keeping of records, and so forth. Because the first prize went to a silage made from permanent pasture, that is not evidence of the superiority of permanent grass over leys. Quality depends on the age of the material ensiled. No amount of attention to the details of ensilage can convert old stemmy grass of low protein content into a high quality product capable of replacing part of the production ration of stock.

Congratulations then to the winning teams of our young farmers, who demonstrated so ably that waste-free silage of high feeding value—"cake-substitute"—can be produced when the crop is cut at the right stage, ensiled skilfully, and sealed and thatched immediately. The type of silo counts less than the skill of the workmen, and the outlook of the winning club is worth repetition: "Here is a job to be done, here are the rules to be followed, let's tackle it properly, and then the stock won't complain".

INBREEDING AND LINE-BREEDING

JOHN HAMMOND, D.Sc., F.R.S.

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WHEN the improvement of live stock was first given serious consideration in Britain the practice of inbreeding was adopted to provide a sufficiently high concentration of the blood of superior animals and thus ensure their prepotency over the inferior animals with which they would later be mated in ordinary herds. For example, the following Table shows the pedigree of the famous bull "Comet," which had such a great influence on the development of the Shorthorn breed :

Comet	**Favorite**	Bolingbroke	FOLJAMBE
			Young Strawberry
		Phoenix	FOLJAMBE
			Favorite Cow
	Young Phoenix	**Favorite**	Bolingbroke
			Phoenix
		Phoenix	FOLJAMBE
			Favorite Cow

Not only was he inbred—see the names which occur more than once on both sides of the pedigree—but his sire, "Favorite," was also inbred to the bull "Foljambe" ; and the latter sire also occurs on the dam's side of his pedigree. As will be seen, "Comet" was the result of mating a sire ("Favorite") to his daughter ("Young Phoenix").

Some time later, when Herdbooks had been introduced to maintain the improved stock pure and to concentrate the blood of superior animals, it was discovered that these pedigree animals were actually more prepotent and more certain breeders of good quality stock than the equally productive animals obtained by outcrossing the pedigree stock with unrelated animals of mixed origin. Although outcrossing frequently gave superior animals, they failed to breed with the same degree of certainty that characterized the pedigree animal. It is in the concentration of the blood of superior animals that prepotency and certainty of breeding lies.

In the early days the Herdbook, being comparatively small, contained a high concentration of the best blood. To-day the position is very different ; we have only to consider, for example, Coates's Herd Book, wherein there are some 17,500 calf entries every year. Breeding within the Herdbook—that is, from other pedigree animals within the breed—does not necessarily imply a concentration of blood, although the animals themselves may be of outstandingly high merit.

A Milder Form of Inbreeding A return to methods somewhat similar to those practised by the first livestock improvers would seem to be indicated if, under present conditions, we are to improve prepotency and certainty of breed. It should not perhaps be quite so intensive a form of inbreeding as they practised, but a milder form termed "line-breeding". For example, in herds where the bull used has successfully bred a certain requirement, he should be replaced by another bull that has been bred similarly and which will therefore tend to

concentrate the blood of the superior strain within the herd. For example, the following are the pedigrees of some individuals (B, C and D) closely line-bred to an outstanding sire ("Farceur").

B	**Oakdale Farceur**	**Farceur**
	Mable Farceur	Beauty
C	**Oakdale Farceur**	**Farceur**
	Farceora	Nora
D	**Oakdale Farceur**	**Farceur**
	Farcetta	Chere
	Oakdale Farceur	**Farceur**
		Oakdale Girl

That is, a noted sire has been followed by his son from a dam unrelated to the other animals in the herd. In this case a uniform herd (animals B, C, D and many others) of high merit was produced in a short time.

Here is another pedigree in which the line-breeding—to Kings Stockwell—is continued longer, but is less intense (sires in heavy type).

Maria Superior	**Queens Superior**	Queen Adelaide	**Beauty's King**	**Kings Stockwell**
				Beauty
			Beauty's Adelaide	**Beauty's King**
				Adelaide Countess
		Superior	**Countess Lad**	**Shylock**
				Countess
			Beauty 3rd	**Kings Stockwell**
				Beauty
	Superior Maria	Beauty Maria	**Beauty's King**	**Kings Stockwell**
				Beauty
			Maria	**Kings Stockwell**
				Regina Maria

Naturally there is no hard-and-fast difference between inbreeding and line-breeding; they differ merely in degree of intensity—the following forms of matings are given in descending order of intensity—brother and sister; half-brother and sister; 1 sire herd (where no bulls or cows are purchased); 2 sire herd (where no bulls or cows are purchased); first cousins; half first cousins.

The effect will naturally also vary with the number of generations which are mated in this way; thus one generation of brother-and-sister mating will give about the same intensity of inbreeding that is obtained by eight generations of first cousin matings.

Within most of our pedigree herds to-day it is possible to obtain what amounts to an outcross within the breed itself. This has gained some popularity in certain quarters because some outcrosses produce superior animals; nevertheless, it is a fact that these superior animals fail to breed with that high degree of certainty which the concentration of blood by line-breeding achieves.

"Compensatory matings" are commonly practised by some breeders. By this is meant that they try to cover up some weak point in their cows by mating to a bull which possesses strongly the character required. Therein lies the reason for the many "outcrosses" within the breed. The same thing can, however, be achieved in line-breeding by bringing the required character into the herd by half an outcross only; for example, by mating a bull bred in the herd in question to an outside cow with the desired characters, and then using a bull from this mating on the herd. This was done in the second example of pedigrees quoted above by the mating of "Farceur" to "Oakdale Girl" and the use of his son, "Oakdale Farceur," on the herd. The required character is then introduced without disturbing the blood concentration within the herd.

So far we have considered only line-breeding within pedigree herds, but the same principles apply, with even greater force, to the grading up of a mixed herd by the use of pedigree bulls. If the progeny of one bull are subsequently mated to another pedigree bull having few ancestors similar to the first bull, there will be little concentration of blood. But if the second bull has been bred on similar lines to the first, a concentration of blood will quickly be obtained in the graded-up herd, leading to an increased prepotency, and greater uniformity and certainty of breeding.

It must, however, be stressed that the basic animals should be known with certainty to have had good records of performance; without this, no system of line-breeding can be expected to produce outstanding results.

UPGRADING DAIRY HERDS WITH PURE-BRED SIRES

David L. Pattullo

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THE pre-requisite of successful dairy farming is a good herd of healthy dairy-type cows; and the sure and economical way to attain it is by a carefully planned and well-managed system of home-breeding. The herd should be self-contained; all heifer calves should be reared, and, with luck and good management, there will be a surplus of females for sale each year—an item which adds materially to the total gross revenue from the herd.

While we pride ourselves on our possession of the finest pedigree stocks in the world, it is generally accepted that many of our commercial herds leave much to be desired. Records of milk sales are incontrovertible evidence of the crying need for improved productivity. The sooner, therefore, each and every one of us begins to consider how best the process of levelling up may be accomplished, the better.

Progressive Improvement The solution is not to be found in either wholesale slaughter or extensive culling. Grading up must be our aim, and it can be attained within the herd by the use of a suitable sire. Relatively few cows are so bad that if mated to a suitable sire they will fail to produce female progeny of better appearance and greater

productivity; and these, in turn, may well continue the process of improvement. This is not to say that some culling is unnecessary, but it need not be carried to extremes. Every cow capable of paying her way can continue to fill a stall, produce a better daughter and leave a profit until the better home-bred animal is available to take her place.

It is quite unnecessary for upgrading to start with a pure-bred female stock, but it is essential that the bull should be not only pure-bred but the son of known stock and *pedigreed*. Good dairy cows can be, and frequently are, got from cross-bred females, provided—and this is the all-important point—*that they are the proper sort of cross.*

Quality of the Bull What *is* the proper cross? The answer is to be found very largely in the quality of the bull. It must have been bred for milk production, with a record of good performance over a minimum of three generations, and with the tendency towards a long working life. These characteristics call for special attention to be given to the conformation of the udder, feet and legs; in short, the wearing parts, since a breakdown of any one means the shortening of the life of the cow. To use a bull which may transmit defects in these respects to his progeny is to court trouble—no matter how good the milk performance records of his ancestry. Both his mother and his grandmother must be the right sort of cows. His strain must be known to possess hardy constitution, he should have a deep frame with plenty of room round the heart, short straight legs of fine bone, and clean hocks; on the female side, a capacious and shapely udder built into the frame (not hung on) well forward under the body and expanding sideways when full, a prominent milk vein, and with production records of 700–800 gallons of at least 4 per cent. butter-fat in each lactation under average conditions (1,000 gallons under good management) and an expectancy of life approaching ten lactations.

1. **Ickham Panther** (born 1936). The kind of Pedigree Ayrshire Bull which Mr. Pattullo is using to upgrade his herd.

Dam—ICKHAM CREAMPOT	*Sire*—BARGOWER GOLD LINE
1,460 gal. at 3.85 per cent. B.F. 1,207 gal. at 4.0 per cent. B.F.	Dam of sire averaged 1,064 gal. at 4.3 per cent. B.F. for ten lactations.

2. **Binkie** (born 1937). This animal, which is the result of a pedigree Ayrshire mating with a Jersey × Shorthorn type, demonstrates well the prepotency of her Ayrshire sire. She is now in her fifth lactation and her average for four lactations is 1,050 gal.

3. **Mabel II** (born 1941). A second cross by a pedigree Ayrshire bull on Shorthorn-type cow.

   Dam—Ayrshire × Shorthorn-type   *Sire*—SEAL VICEROY

   Five lactations, averaging 1,100 gal.

4. **Nellie II** (born 1940). A third cross by a pedigree Ayrshire bull on Shorthorn-type cow.

   Dam—Double Ayrshire × Shorthorn-type.   *Sire*—SEAL VICEROY

   Two lactations, averaging 1,042 gal.

[Photos. *Claude Hosegood.*


②
①

Photo. *Preston Guardian*

THE INGLENOOK (See pp. 220-223)

Inglenook at Claughton Hall Farm Mr. Novel Bargh entertains.

Choice of Breed Bearing these points in mind the producer must decide which breed of bull he will use. He should consider carefully the relative advantages of the various breeds of dairy cattle, disregarding all consideration of beef or dual purpose. His problem is to choose the breed in which he is most likely to find bulls capable of imparting the qualities of a good milk cow to his progeny. Once this question has been decided, the breeder must adhere to his choice and never thereafter change the breed of the bull unless the first decision proves to have been a mistake. Rather should he seek to introduce by each successive purchase a better animal than its predecessor. Actual choice of sire should be based on the conformation of the bull, in addition to a close inspection of his dam and, if possible, grand-dam and near relatives.

Vacillation in policy, influenced perhaps by the "sales talk" of bull sellers, is fatal to success. All pure breeds have their especial uses, and by a policy of judicious cross-breeding these uses can be extended, but the production of mongrels by indiscriminate crossing—due partly to thoughtlessness and partly, by small farmers, to lack of access to a suitable bull—is the strongest proof of inefficiency in present-day stock farming and should be rectified at the earliest moment.

Grading Up with an Ayrshire on a Mixed Herd My own herd is non-pedigree—not even pure-bred—and, in consequence, I am not a bull breeder. My animals are retained on their performance records; that is to say, on their capacity to give milk of quality and quantity, and to produce female calves worth rearing for dairy purposes. I chose the Ayrshire as my breed of bull, and have consistently used pedigreed Ayrshire bulls from cows whose line was of the type described above. From observation and experience, I believe bulls of this breed "knit" better than those of any other with nondescript cross-bred cows, and that their use maintains a uniform level of improvement in succeeding generations. Starting with a herd of mixed breeds and maintaining this policy of quality Ayrshire sires, I have been able to grade up to a degree which would please the most fastidious.

It may be contended that there are not enough Ayrshire bulls to allow of any great increase in their use as sires. I do not think this is true. Admittedly, the pedigree breeder is, at the present time, catering only for the pedigree trade, but hundreds of pure-bred bull calves eminently suitable for grading up commercial herds are being sold for slaughter. There can be no doubt that if the commercial herd owner made the demand, it would quickly be met by pedigree breeders. These pure-bred animals are not slaughtered from choice—only from necessity, and in the absence of any demand for them. There is a real need for closer association between commercial and pedigree breeders, and I think the pedigree owner will be found anxious and ready to help the rank and file of stock farmers by supplying at reasonable prices bulls to suit the purpose.

Individual owners who adopt the policy outlined in this article will, with little capital expenditure and little disturbance of their routine, reap greater profits and real satisfaction. They will play their parts in removing a slur on British agriculture by improving the appearance, health and stamina of our dairy cattle. The home-bred, self-contained herd will offer full opportunity for the control of those diseases which take such a toll of our profits. It will give full backing to the campaign to create a healthier Britain by increasing milk consumption.

MONTGOMERYSHIRE CALF-REARING SCHEME

W. Ellison, Ph.D.

Montgomeryshire War Agricultural Executive Committee

MANY counties have recently been making inquiries concerning the calf-rearing scheme initiated in Montgomeryshire. This scheme, which has been in operation for over 12 months, was originally devised to meet the peculiarities and difficulties of the various types of farming in the county in relation to milk production. Like most counties in Wales and western England, Montgomeryshire has a large number of farms which, because of their situation, inaccessibility, inadequate water supplies and similar reasons, are unsuitable for milk production. On the other hand, many of the farms which have gone into milk production during the past 15 years or so have become self-contained in that they rear all heifer calves for herd replacement. In the past buying in cows has often meant buying disease and trouble.

Scheme Aimed at Increasing Milk Output

This policy of rearing heifer calves on suitable dairy farms has, however, resulted in less milk being available for sale. The Committee felt that if these heifer calves could be reared on upland farms unsuited to milk selling, the county output of milk from suitable farms could be appreciably increased. Therefore a scheme was put into operation whereby upland farmers willing to rear dairy calves for a payment of 25s. per month each should apply to the Committee, who in due course would inspect the buildings and general facilities and, if satisfied, approve them. Similarly, dairy farmers who wished to put out calves to rear on approved upland farms were asked to notify the Committee. The Committee then established contact between the two parties and assisted in the preparation of a suitable contract. No financial liability was accepted by the Committee, who acted merely in a supervisory and advisory capacity. Where possible, calves from attested milking herds were placed on attested rearing farms. The general conditions of the contracts arranged are as follows:

1. All arrangements must be made through the War Agricultural Executive Committee.
2. Appropriate agreement forms must be prepared by the War Agricultural Executive Committee, and one copy, bearing the signature of both owner and rearer, must be deposited with the Committee.
3. The owner is required to pay the rearer 25s. per calendar month for not less than 12 months and not more than 16 months (unless otherwise agreed by both parties).
4. Where death of the calf occurs on the rearer's farm, the owner must pay the rearer half the agreed rate for the time the animal was on the rearer's farm. In all cases the Committee advises the owner to take out an insurance policy.
5. All calves must be inoculated against "blackleg" at the owner's expense.
6. Where in the opinion of the Committee rearing is being carried out in an unsatisfactory manner, the calves are removed and the amount to be paid to the rearer decided by the Committee or its appointed arbitrator.

7. Both parties must agree to the Committee acting as arbitrator in any case of dispute or to abide by the decision of an arbitrator appointed by the Committee.
8. Periodical inspections of the calves are made by an official of the Committee, and a copy of his report is sent to the owner.

Economic Benefit to Both Rearer and Owner

The scheme is still in its infancy, and changes may have to be made in the light of further experience. So far, however, over 100 dairy calves belonging to private farmers are being reared satisfactorily under the scheme, which has definite economic attractions to the rearer, in that he has a guaranteed return which at the end of 16 months will amount to £20. Few upland rearers have been able to obtain such a good return in the past at the same age for the class of cattle they normally rear. At the same time the owner of the heifer is well satisfied to have a good, well-bred animal at this price. As regards dairy calves, the Committee has not insisted on the rearer rearing an increased number, since it is considered that the saving in milk justifies the upland farmer disposing of some of his own calves, usually inferior, so that he can rear those of a better type. The Committee itself has bought a few dairy calves to be put out under this scheme on approved farms which at the time could not be provided with calves from private farmers.

Extension to Beef Calves

The Committee, in its anxiety to stop the slaughter of both beef and dairy calves fit for rearing, has decided to extend the original scheme to include beef calves, and is prepared to acquire a larger number of calves under the arrangements made between the Ministry of Agriculture and the Ministry of Food whereby calves suitable for rearing are recovered from the grading centres. The Committee will, of course, also assist in making arrangements between private farmers. On farms which are approved as suitable for rearing calves of a beef type, the farmer will be expected to rear any agisted calves in addition to those normally reared, except where it is agreed by the Committee that his own stock are of inferior quality ; in this case they should be sold for slaughter. The rate of payment to the rearer will be 25s. per month, as for the dairy scheme.

The Committee has purchased a small number of bull calves with a good lineage as potential sires, and these have been placed on approved farms to be reared under the same forms of agreement as previously mentioned, except that the period for rearing will be only 10 months. The Committee is considering the payment of a bonus at the end of this time, in addition to the usual monthly rate, according to how well the bull calf has been reared.

War-time Experiments may have Permanent Value

These rearing schemes are purely war-time experiments made in an effort to solve specific problems. The dairy calf-rearing scheme may, however, have more permanent possibilities, since it appears that by marrying the upland and lowland farm in this way, the upland farm may enjoy more economic stability. Many upland farmers are beginning to realize that their economic future may be more certain if they turn over to producing disease-free replacement stock for the milk-selling farms instead of store beef cattle as they are doing to-day. Such a change-

over, however, is a slow process limited by several factors, one of the more important of which is the capital necessary to purchase a basic stock of dairy-type animals. Many such farmers are, in the meantime, rearing dairy calves under the agistment scheme,* and in some cases they have expressed a strong desire to purchase the heifers for themselves at the end of the rearing period. With heifer calves owned by the Committee, this may eventually be arranged.

The development of the calf-rearing schemes may command the confidence of both the Committee and the owners of the calves, since the calves are being reared by farmers who are past masters in this particular work.

THE INGLENOOK

J. E. HARGREAVES

Agricultural Editor, The Preston Guardian

AGRICULTURAL discussions are no new thing to Lancashire. It was in this county, I believe, that Agricultural Discussion Societies originated many years ago, and they flourished vigorously up to the outbreak of war. In many parts of Lancashire these societies function still, in spite of the troubles occasioned by black-out and transport. This keenness for discussion of common problems is one of the most encouraging features of farming life in Lancashire, and indicates the readiness of the farmer to talk over new ideas and to argue with the scientist or the expert the application of theory to practice on the farm itself.

The war, however, has brought its own developments of communal discussion groups. The old-time lecture, followed by questions and general discussion, has been replaced by the "Agricultural Brains Trust" and the "Quiz," by open-air talks at demonstrations, and by group discussion of B.B.C. farming broadcasts—such as the *Cattle at the Cross-roads* series. The farmer has never displayed a greater interest in discussion groups than he is doing now; for every single Agricultural Discussion Society meeting held before the war, there are to-day at least a dozen. There is not a rural community or village in the county that has not, at some time or other since the war began, been visited by a "Brains Trust" or a film unit. Lancashire farm folk seem to thirst for knowledge like a bee for nectar.

Fireside Informality Against this background, it was decided two winters ago to launch a new form of agricultural discussion. Begun purely as an experiment, it was termed "An Inglenook Talk" and rapidly became an accepted feature of the winter's agricultural education programme. The sponsors were *The Preston Guardian*—the Lancashire agricultural paper—and the Lancashire War Agricultural Executive Committee, jointly.

* The Montgomeryshire scheme for the agistment of cattle on improved upland grazings was described by Dr. Ellison in the June, 1944, issue of this JOURNAL (pp. 105–7).

The original idea—and it has never been found necessary to depart from it—was that a farmer acting as host should invite a number of his neighbours to his farm kitchen to talk over agricultural problems, both of general and local interest. Behind this idea lay the feeling on the part of the sponsors that if farmers could be gathered around a fireside on a winter's evening they would talk far more readily than they would at a more formal discussion in the village institute or lecture hall. At the latter kind of meeting, good as this has always been in Lancashire, never more than about 10 per cent. of the audience actually voiced their views; many farmers, although keen listeners, are shy of speaking in public. We contended that in homely surroundings and amongst their own neighbours even the most reticent would contribute his share to the conversation, and in this we were not mistaken.

Guests Selected by the Farmer From the beginning we refused to exercise any control in the selection of guests by the farmer; the choice was entirely his, although we suggested that the number should not exceed eight. This was because we wanted everyone to be comfortable, to be able to smoke and chat with complete informality. In other words, we sought to preserve the atmosphere of a real inglenook. In the majority of instances, of course, the "inglenook" itself was left largely to the imagination, since many farmers' wives , as progressive in their own sphere as their husbands are in theirs, have insisted upon the replacement of the old-fashioned, wide, open fireplace by modern tiled grates!

In addition to the farmer guests, the District Officer for the area in which the talk was to be held was always present to answer technical questions, as was also the Demonstrations Officer of the Lancashire War Agricultural Executive Committee, Mr. F. R. W. Craddock, who was responsible for making the necessary arrangements for each talk. It was my duty to write up a review of the talks week by week for *The Preston Guardian.*

No restrictions were placed upon the subjects discussed. My reports were uncensored and, I hope, faithful records of the extremely frank talks that took place. Although the War Agricultural Executive Committee was joint sponsor of the discussions, no ban was placed upon criticism of the Committee's work; yet, strangely enough, I cannot recall a single instance where this occurred—no doubt a reflection of the good relations which the Committee enjoys with the farming community.

The First Inglenook I well remember our first Inglenook. It was on a winter's evening just before Christmas, 1941. The whole idea was so novel that none of us quite knew what to expect, and, very naturally, we were rather apprehensive. When first we debated the scheme we were even worried whether we would be able to persuade a farmer to act as the first host. We approached Mr. J. Whewell, of Tarnacre, St. Michaels-on-Wyre, and he accepted without demur, placing himself and the resources of his home unreservedly in our hands. It was true Lancashire hospitality, and I shall always be grateful for it, since upon the success or failure of that first Inglenook talk the fate of the whole idea depended. Good luck was with us all the way, however, for we were able to get Mr. Tom Stuart, J.P., of New Hall, Sowerby, Chairman of the Milk Recording Society and one of the leaders of Lancashire farming, to come along and

give us a helping hand. Mr. Whewell invited a goodly company of neighbours, chosen apparently for their willingness to argue their heads off, if necessary, and everything went very smoothly.

Doubtful whether we would be able to get the discussion started, and appalled by the thought of one of those sudden silences occurring that so completely ruin any discussion, Craddock and I had prepared a list of questions we intended to ask in order to keep things moving at a sharp pace. It was wasted effort: we had no need of it, and at all the subsequent Inglenooks it was the same story. The only doubt that arose was whether my shorthand speed would be equal to the strain. How those farmers talked! No matter what district we went into—and we visited each part of the county in turn throughout the two winters—they went at it without a break. I am, however, glad to record that the reports of the talks attracted a wide reading public, and the diverse views expressed, often forcibly, by adherents to this or that system of farming, were re-stated and argued again in farmhouses throughout the North-west.

Every farming topic under the sun was discussed, but the fiercest argument centred on the value of reseeded land as compared with that of old pasture or meadow. Farmers never tired of this subject, and many notable points were made.

A Cross-section of County Opinion During the past two winters some 50 Inglenooks were held and about 400 farmers took part in the complete series. This is not a large number in itself, but, when it is remembered that every one of those farmers talked quite freely and had his views recorded, it represents an important cross-section of opinion throughout the county. The talks were of a remarkably high educational value, and provided both the expert's solution of various difficulties and the farmer's practical adaptation of varying systems and principles. They also enabled us to maintain close contact with trends of opinion held by farmers upon many important topics. In getting over advice upon the methods necessary to secure maximum production in the widely varied types of farming in Lancashire, these talks have, in their results, proved to be without parallel. The letters I have received from farmers indicate that many of the ideas suggested at these Inglenook talks have been adopted with great success.

In Retrospect Unfortunately it is quite impossible within the limits of an article to review all the talks individually; I must, therefore, confine myself to a brief mention of just two or three, not because they were of greater importance than the rest but because they were, in their own way, unique.

The first of these was held last winter at a North-western base of the United States Air Force. Feeling that we ought to know something of the American attitude to our farming, and that our allies should learn something of our methods and problems, I suggested that an Anglo-American Inglenook should be held. Public Relations Department at the base was approached and, as we had hoped and guessed would happen, our American friends insisted upon acting as hosts.

This was obviously a rather bigger affair than the usual run of Inglenook talks. As it was held under the comforting shadow of "Old Glory" in the American camp, there was, of course, no inglenook to be seen. But it was a great success, particularly as the B.B.C. came along and recorded it for the North American programme. This Inglenook was particularly interesting as a frank exchange of views on the future of international agriculture, and it was subsequently given a very wide public, for it was reported in newspapers all over the United States. The Americans had about ten boys there—all pre-war agriculturists—led by Major Kennedy; we had a similar number of farmers, representing the different farming areas of the county, led by Major J. Fitzherbert-Brockholes, Chairman of the Lancashire War Agricultural Executive Committee.

Naturally we were not to be outdone in hospitality and, later, we returned the invitation through Mr. D. W. Lane, who is reclaiming some land in the Fylde at considerable expense. Quite frankly, I have been engaged in no enterprise that I feel has fostered greater understanding than these Anglo-American talks. We got to know the viewpoint of the United States' agriculturist, and for our part we left no doubt as to our own position. The air was cleared on both sides in such a way that nothing but good can result. Beyond that, a number of fine friendships were formed which time has subsequently strengthened. Some of the Americans expressed a wish to take part in an Inglenook held in a typical Lancashire farmhouse, and we took them with us to more than one. The first we selected was ideal, in that it had a real inglenook several hundred years old. This was at Claughton Hall Farm, Lancaster, and the host was Mr. N. Bargh.

The second Inglenook which I have chosen for special mention was almost the last of the series—namely, that held at Manchester University, where the guests were all agricultural scientists. The host was Mr. Arthur Jones, head of the Agricultural Department of the University, and he had gathered around him the men in charge of the various branches of agricultural research in which this university is interested. If ever there was a feast of knowledge served up for the agricultural community it was here, and the value of this Inglenook must rank high in the list because of the amazing amount of material provided by these "backroom boys" who discussed North-western agricultural problems from every angle and contributed many valuable suggestions upon knotty problems.

Hospitality in the Inglenook

Finally, there is one aspect of the Inglenook proceedings that has not previously appeared in print, but which I feel I should now mention, if only to indicate our indebtedness. I refer to the fifty farmers and their wives who acted as hosts and hostesses and simply showered upon us a lavish hospitality. On no occasion was the question of refreshment suggested. This was left to the host, but as though it were an unwritten law, and something never to be mentioned in advance, supper was always provided. The trouble that farmers' wives and daughters took to see to our creature comforts provides a happy memory and made me extremely sorry when the closed season for Inglenooks arrived.

COUNTRY MAGAZINE: AN EXCERPT

COUNTRY MAGAZINE, broadcast in the Home Service on July 2, 1944, brought to the microphone some of our overseas visitors.

Wine Production in Portugal Mr. C. H. D. Danvers, who comes from Portugal, commented that the one form of farming unsuitable for machinery is vine-culture. Labour is plentiful and cheap in Portugal, and almost everything is done by hand—grafting, staking, pruning and picking. There are, of course, machines for crushing the grapes, but in his view they are of no use. "Bare feet can feel exactly what pressure to give. They don't break the grape-stones, and the warmth of the human leg assists fermentation." The treading is usually done inside a long building, with the lagars, or stone tanks, arranged down one side. It is weird to see twenty or more men dancing a fandango in a stone tank to the accompaniment of guitars, flutes and drums, and with the purple wine up to their thighs. Actually the process is very skilfully worked out. "At first they have to go slow and step very high so as to leave no whole grapes above their feet. The pace is gradually increased, and near the end we prime the men with music and brandy. It's like a spark to a powder barrel. Their primitive sense of rhythm must express itself and they dance on the grapes. The speed improves the colour of the wine."

A South African looks at Our Countryside Mr. C. J. Cilliers comes from the Karroo district of South Africa and is greatly impressed by the healthy green vegetation of our countryside. For many years he has been accustomed to the arid conditions of the north-western part of the Cape Province. He was born on a farm of 23,000 acres, but of this "nice little holding," as somebody described it, only 400–500 acres were arable; the rest was grazing, and, at that, not grazing as we here understand it. "The whole farm only held about 4,000 sheep, mostly Merinos for wool, and maybe 200 head of cattle; and except in very good years, when we get about 10 in. of rainfall, there is hardly any green to be seen." Our small fields naturally appear very strange to him. "The English countryside," he said, "looks more like a large-scale map than the real thing. That seemed very picturesque at first, but from a practical point of view I don't think there's much to be said for the hedges. As far as I can judge, they take up much more of an English farmer's time than my father would spend looking after his wire, and I think they waste a lot of ground."

A Land Girl from Iceland Mrs. Iris Tye, whose home is in Iceland, is in the Women's Land Army, where she has found an outlet for her enthusiasm for the freedom of country life. Like many of our own girls, she is town born and bred and had no previous experience of farm work. She admitted: "I am very frightened of cows and bulls. But it is all right: in the Land Army we are not all milkmaids, and there are many jobs I can do without being frightened by the cows and bulls. First of all I pick potatoes; that is all right—I like it. I am outside in the fields all day in the fresh air. Then next I go out with the milk in a horse and cart. That I like very much indeed—I am not afraid of the horse, and it is fun to drive all round in the cart. You see a lot and get to know people and talk to them. English people are friendly. The next job I have is spreading muck. I spread an awful lot of muck. After that there is snagging turnips and making fences and cutting hedges. The

weeks go by and soon it is time for setting potatoes. All these jobs I like quite well, especially making fences. It is good work that, and interesting, but I still like the milk round better than anything."

Indian Farming Mr. Umrigar was born in Bombay and spoke of its hot and steamy climate in summer. "During the monsoon," he remarked, "you might put your shoes aside for a couple of days and find them grown over with fungus. I hear your farmers grumbling, but there are millions of things in my country which you never even dream of over here. There's drought to fight, there's disease to fight. Your country people are worrying now because they don't get enough rain. That is quite serious for them because it means a poorer crop and perhaps some very short straw, but in my country you may get one, two or even three years without enough rain; and even one year may mean *famine.* Of course irrigation schemes have turned hundreds of acres of desert into rich farming land—like the Punjab canal colonies, but even there the peasants are poor. By that I mean that in the good years they may get just enough to eat. Your English farmers work very hard, especially now. I've talked to a lot of them, and you've only got to look at a man and look at his hands and everything to know that he works hard. But your country people get a decent living out of it. In my country what they get out of it is very, very small."

A Market-gardener from Guernsey And there was Mr. Jack Roberts of Guernsey, who escaped to this country only last year. "I had visited England many times before, but it's only now that I've realized how kind people are. I find people writing to me to ask if they can help—complete strangers sometimes. It's surprising to think of this, because I've noticed that the English growers keep apart from each other a good bit. I don't mean they're unfriendly amongst themselves. But one grower hasn't got the same desire to help another over troubles (that's to say, help his competitor) as we do on the Island. I have now gone into partnership with another Guernsey man, and we've taken over a nursery in Essex. It was too short notice actually to get going and prepare all the soil as we would do at home. We managed to get two houses done our way, but the rest were done in the usual English manner. Our two houses are streets ahead. I don't like these houses we have in Essex: you could never plant five houses and get the same growth right through. You get cold patches sometimes, and other patches with a faster growth. Then here we have one furnace for several houses, and you can't get up the same heat. That strikes me as odd, because there's more need of heat in this country. I've had this out with English growers. They plant across the pipes. We plant along the line of the pipes, which keeps each of the plants in the same heat. Planting crossways—I've noticed it here and I've noticed the same thing at home—your plant nearest the pipe is the one that ripens first. So why not plant them all along the pipe, and have none of them stretching their necks between each truss?"

"Welcome to all visitors," said Mr. Eaton, who comes from Gloucestershire. For hundreds of years we've had visitors over here for one reason or another—wars and persecutions—and they've always taught us something."

TAKE-ALL OR WHITEHEADS OF WHEAT AND BARLEY

W. A. R. Dillon Weston, M.A., Ph.D.

School of Agriculture, Cambridge

SOME plant diseases are carried over from year to year by the sowing of contaminated or infected seed, whilst others arise because the seed is sown in contaminated soil. A number of seed-borne diseases can be prevented by dressing the seed before sowing with a reliable organo-mercury seed dressing, but this treatment will be of little or no avail against soil-borne diseases, and in this category falls the Take-all or Whiteheads disease of wheat and barley.

This disease is caused by the fungus *Ophiobolus graminis* and is likely to appear when rotations are shortened and white-straw crops taken too frequently. The reason for this is that the mycelium of the fungus survives in the soil in the root and stubble residues from a previous infected wheat or barley crop, or in the root and haulms of infected grasses.

How the Disease may be Recognized In the early stages of growth Take-all occasionally appears in irregular patches in the field, and in these the plants are stunted; but as these symptoms may arise from other causes, a laboratory examination is necessary to determine if the fungus mycelium is present at the base of the stem. The most characteristic feature of the disease is seen shortly before harvest, when affected plants ripen prematurely and produce bleached ears containing little or no grain. These plants are termed "Whiteheads," but it should be noted that these bleached ears may later become greyish-black if the harvest is wet. This change in colour is caused by the mould fungus *Cladosporium*, but it need cause no concern, as it is incapable of producing disease in living cereal plants. Another symptom of "Whiteheads," which distinguishes it from white ears arising from other causes, is the black discoloration of the base of the stem, the grey colour of the roots, and the ease with which they break when a plant is pulled from the soil.

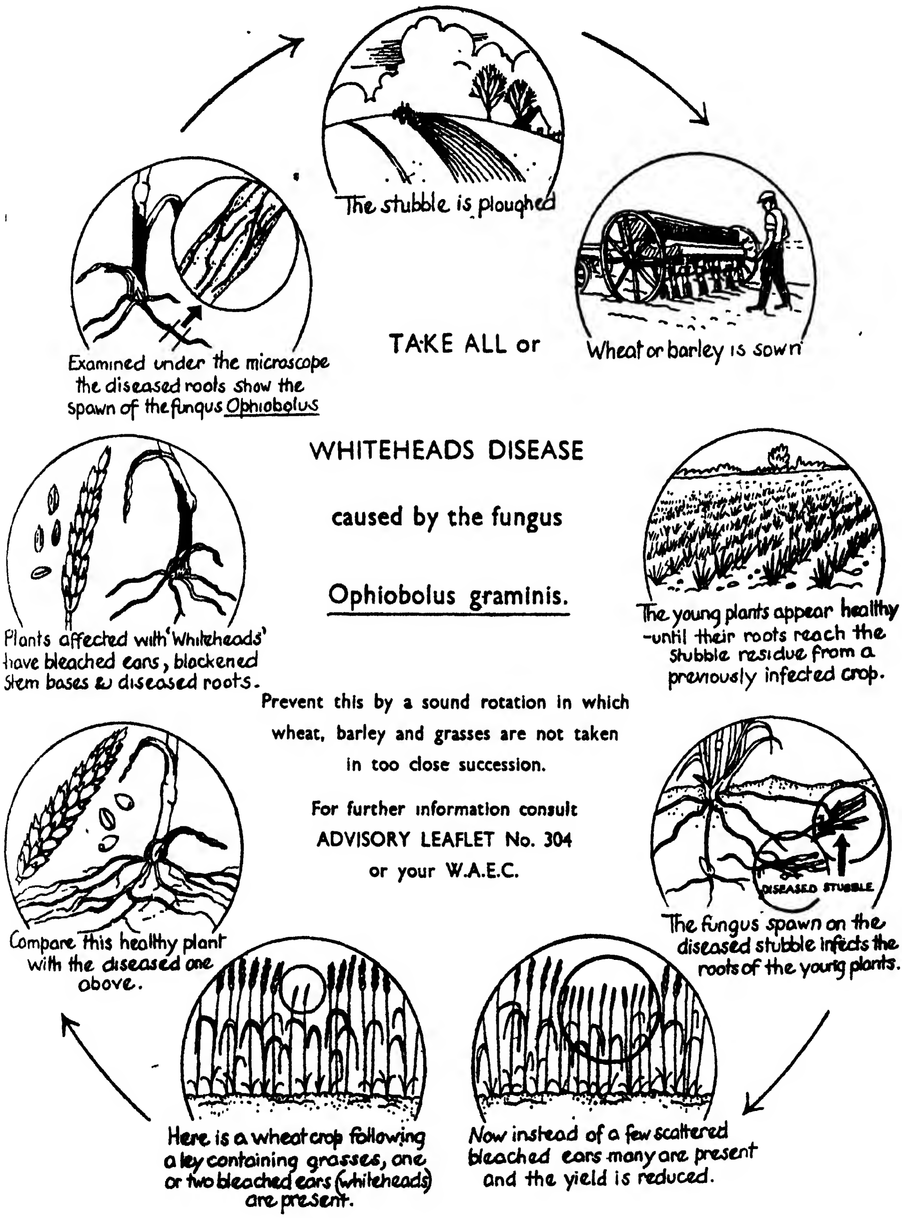
When these symptoms appear it is usually a danger sign that white-straw crops have been taken too frequently in the rotation and that, as a consequence, the soil has become contaminated with the Take-all and Whiteheads fungus.

Control Measures If the disease has been observed in a wheat or barley crop, it should not be followed by either of these crops, and this applies particularly on light-textured soils, especially those overlying chalk. If a corn crop is imperative, then oats should be taken, as it is unlikely to be affected—except in Wales and the North of England, where a special strain of the Take-all fungus that attacks both oats and wheat is not uncommon.

As crops other than cereals and grasses are not attacked, the most effective method of control is to starve out the fungus in the soil by avoiding susceptible plants. This is not difficult, as the inclusion of a non-cereal crop, such as the rootbreak in the Norfolk four-course rotation, is often a sufficient precaution. It should be remembered, however, that as the fungus may affect grasses, temporary leys containing these will not starve the fungus from the soil, although they may reduce the severity of a subsequent attack on wheat or barley. Lastly, potent sources of infection are the weed grasses, Yorkshire fog, couch grass and bent grass, for these are as bad as a wheat or barley crop in permitting multiplication of the fungus in the soil.

See illustration of Take-all fungus life cycle opposite.

TAKE-ALL OR WHITEHEADS OF WHEAT AND BARLEY



GRAIN STORAGE ON THE FARM

THERE is nothing new in the problem of storing grain. One of the triumphs of Joseph was to carry over grain from the seven fat years to feed the people in the seven lean years. In the very dry climate of Egypt his problem was less difficult to solve than in Britain, where grain has a much higher moisture content when cut and the atmosphere is more humid. However, the large tithe barns of the Middle Ages and the present great stone granaries of the Lothians and the North of England are examples of the provision which our forbears made for grain storage. Those farmers who have large barns or any form of large covered space, including Dutch barns, can easily improvise storage for grain in sacks and even for grain in bulk. The problem is more difficult on those farms in former grassland areas, which have little in the way of "cupboard" space. Some suggestions are made in these notes of the way in which protection from the weather can be provided with little labour and at low cost.

The problems of grain storage for the ordinary farmer may be examined under four heads:

(a) Protection from the weather;
(b) Forms of bulk storage;
(c) Sack storage;
(d) Methods of handling grain.

Protection from the Weather Grain should never be stored under conditions where it is exposed to rain or damp. In Western Canada grain is sometimes left out in the fields for months—in bags piled on straw and covered with tarpaulin, or in rough timber bins. But what is possible in the dry, cold winter climate of Canada is not possible in Britain. Even if it becomes necessary to leave grain in a field overnight, sacks should be stood on planks or straw, and covered with a sheet. For more permanent storage grain should be protected from the weather by a proper roof, walls and floor. Any form of building can be used, provided that it is thoroughly weather-proof and structurally strong enough to support the weight of the grain. If no regular barn or other building is available, a Dutch barn can be used by filling in the sides with asbestos sheets or corrugated iron. A concrete floor, surfaced with asphalt or other suitable waterproofing material, should be provided, although as a make-shift for short storage, clinkers or ashes may suffice on a naturally well-drained site. In the absence of a Dutch barn, a temporary building can easily be constructed from large pole framing covered with either galvanized iron or asbestos cement sheets. The sides can be made of the same materials or even of straw bales. The large lorry packing case sections which the Timber Control have for disposal can be used to make useful buildings and floors. Any farmer wishing to buy these sections should approach his County War Agricultural Executive Committee, giving particulars of the type of buildings he wants to erect.

More permanent buildings can be made from ferro-concrete. There are available a variety of buildings made from pre-cast concrete units, particulars of which can be obtained from builders, architects, or from the Cement and Concrete Association, 52, Grosvenor Gardens, London, S.W.1. Another type of building which can be made from concrete is the Ctesiphon hut—an arched building rather like a small aeroplane hangar. Farmers should in all cases remember that there is at present a strict control over civil building, and if they are not already familiar with the details, they should get in touch with the Regional Licensing Officer of the Ministry of Works.

Forms of Bulk Storage Provided that grain is dry (moisture content of 14 per cent. or less for wheat and oats, and 12–14 per cent. or less for barley) and that the farmer has elevators or other means of moving it, one of the most satisfactory methods of storing grain is in bins. As all farmers know, grain, like water, exerts an outward thrust, and therefore no attempt to construct bins should be made without advice from an architect or builder. The brief particulars which follow are intended only to indicate to farmers some of the types of bins which can be obtained in war time.

BRICK BINS For brick bins the back and sides should be of 4½-in. brickwork, rendered with cement on the inside. If the bins are to be formed in a building of substantial construction, only sides and front may be needed. The front should be of 1½-in. timber or 2-in. concrete planks, set in grooved posts so that they can be inserted or removed as required.

CONCRETE SILOS Many types of pre-cast concrete silos are on the market, and some will be suitable for grain storage if placed under cover.

If tall silos are used special care must be given to the arrangements for filling, in order to avoid man-handling heavy loads of corn to undesirable heights. Make sure too that the structure is strong enough to withstand the lateral thrust of the grain.

STEEL BINS Many commercial makes of steel bins are on the market and can be supplied according to individual requirements. They should be on the lines of static water tanks, and not more than 4 ft. deep.

PACKING CASES It is suggested that bins quite suitable for the bulk storage of grain can be made from packing cases which have been used for the importation of agricultural machinery and various motor vehicles. It is difficult to give precise details of these, and the reassembly of the sections to form bins will depend largely upon the ingenuity of local craftsmen. The cases are of various sizes, so that farmers should state their requirements and, if possible, inspect the various components at the nearest depot, of which there are many up and down the country. Particulars can be obtained from County War Agricultural Executive Committees.

It is assumed that all bins will be kept under cover and protected from the weather and vermin. They should be provided with a tap controlling an outlet at the bottom, through which the grain can be let out for bagging or turning over. Care should be taken that walls are well braced and that all floors are raised above the surrounding ground and made rat-proof.

Sack Storage Grain sacks are in short supply and are needed for threshing and transport. They must, therefore, be kept in circulation. If sacks *have* to be used for the time being, the first principle is that the sacks must be protected from the weather, damp and vermin. The grain should, if possible, be dry. Unless it is certain that the grain is really dry, the mouth of the sack should be left open and the grain examined regularly to make sure that it is in good condition. Sacks should also be stored in a single layer. The safe moisture limit for wheat and oats in sacks for temporary storage is 16 per cent., and for barley 15 per cent.

Another point to be kept in mind is that under the Binder Twine Control Order new binder twine for tying the mouths of sacks must not be used. Twine salvaged from the bonds cut while threshing the previous year's crop should be used.

Methods of Handling Grain If grain is to be stored in bulk in bins or even on the barn floor, some form of conveyor or elevator to move it is of great assistance. Conveyors and elevators generally consist of an endless belt with small cups attached at intervals. These elevators can either be fixed in mills and permanent grain stores or they can be portable. The portable type is hardly known in Britain, although it is common in the U.S.A. and Canada. Another type of elevator is the pneumatic elevator, in which grain is lifted by a current of air from a fan and carried along a metal pipe. The advantage of this type of elevator is that the grain can be carried around corners. A limited number is in production, and farmers who are interested can get particulars from the Ministry of Agriculture, Block 4 Bickenhall Mansions, London, W.1.

Two Problems The foregoing notes may be useful to farmers as an introduction to a subject which is going to be of increasing importance to them. They should recognize, however, that in providing for grain storage they are faced with two highly technical problems: the first is concerned with the building, and the second with the grain. It should be emphasized that to make sure that any structure, whether a building or a bin, which a farmer proposes to erect will be strong enough for its purpose, he should seek expert advice. In the same way, if he has had no previous experience of storing grain for weeks at a time, either in sacks or in bulk, he should make a point of consulting persons with experience, and obtain advice how to judge the moisture content of grain and how to prevent damage from overheating and other causes.

Finally, it may be remarked that some farmers are apt to think that having bought a combine their responsibilities are at an end as soon as they have cut and threshed their corn. It is of the utmost importance that every farmer who buys a combine should recognize that, except in the drier districts, artificial drying will probably be necessary. Farmers who cannot arrange for the sale of their grain as it is cut may have to instal their own drying plant, and in that event they must take special care to ensure that the milling or malting properties of the grain, or its value as seed, are unimpaired. They must also be prepared to arrange for the storage of the grain in good condition on the farm, pending removal to its ultimate destination. As the number of combines in use increases, it will become more and more difficult for merchants, millers and maltsters, or the Ministry of Food, to handle all the grain offered at the beginning of the season.

If you are using a Combine Harvester . . .

Don't cut your grain until it is *dead ripe*—that is, 7-10 days after wheat would be considered fit to cut with a binder.

And for Drying . . .

Remember that a grain drier cannot be used to *ripen* grain. Don't use it to remove "sap moisture".

HOT AIR TEMPERATURES FOR GRAIN DRIERS

National Institute of Agricultural Engineering, Askham Bryan, York

THE use of the correct hot air temperature for each type of grain is essential for successful grain drying. The hot air temperature is usually controlled by a damper or shutter regulating the amount of cold air joining the hot furnace gases going to the drying section. All driers should have two thermometers in the hot air stream, and they should be compared from time to time to see that they are giving an accurate reading.

The temperature of the hot air should never be allowed to exceed the limits given in the following Table :

	Deg. Fahr.
Oats and dredge corn (for milling or feeding)	180
Wheat for milling	150
Barley and seed corn up to 24 per cent. moisture (fairly damp) ..	120
Barley and seed corn over 24 per cent moisture (exceptionally damp)	110
Linseed, mustard, and other oily seeds	115

A higher temperature, operating even for a few minutes, may do irreparable damage to the grain.

When the drier is started the maximum amount of cold air should be admitted to mix with the hot furnace gases. This quantity of cold air should then be reduced gradually until the required ingoing air temperature is reached. Any grain in the drying compartments at the time of starting will not be properly dried and should, therefore, be returned to the receiving hopper to be mixed with the damp grain.

Most driers are designed so that changes in hot air temperature are gradual, but readings should be taken every ten minutes, or a recording thermometer used, to make sure that the safe limits are not exceeded. Until drier operators are fully experienced, it is advisable to work to limits of 10° F. below those recommended.

RAT DESTRUCTION

ALBERT E. DAWSON

Northumberland War Agricultural Executive Committee

THE destruction of rats is by no means a simple task, and their eradication, whether the infestation is large, small, scattered or concentrated, entails much work, patience, perseverance and forethought. Biologists and other scientific workers are constantly investigating the problem by experiments in the laboratory and in the field.

Rats are prolific breeders. Their remarkable fecundity enables them to breed all the year round, and the young females reach sexual maturity at the early age of three to four months. The normal period of gestation is 21 days, and another pregnancy may follow very soon after the birth of a litter. The number of young per litter and the number of litters per year vary, but it is known that litters of a dozen or more are produced.

Our farms to-day are virtually food factories, and therefore they have an even stronger attraction for rats than normally. It is here that rat

destruction must proceed with relentless vigour, outpacing their rate of breeding.

Source of Infestation Quite often the source of infestation may be detected easily, but sometimes a prolonged and painstaking search is necessary before it can be traced. In addition to colonies which may be concentrated near stacks, granaries and food storage centres, the farm itself is likely to carry a *general* infestation. In urban areas man must be held mainly responsible for the provision of food and shelter for rats. Defects in property, drains, ventilators, refuse disposal centres and sewage systems, and carelessness at food and grain stores and warehouses, all contribute to persistent rat populations and increase the difficulties of tracing the source of infestation. Under similar conditions in coastal towns, especially at ports, the black rat may be encountered as well as the brown rat.

The greatest attention should at all times be given to rat-proofing and the removal of rubbish. It is important first to attempt rat destruction and then to carry out such effective rat-proofing as may be possible. Thereafter the remaining infestation can be dealt with more easily and with better prospect of decisive results.

Poisoning Methods of control have not changed appreciably for many years and success depends chiefly on sound, practical measures, covering the widest area possible in one fell swoop. Poisoning, gassing, trapping and hunting are the most practical methods for dealing with rats, and each method may have several variations in practice. The poison method is considered to be of more general application than the others, particularly when the infestation is heavy and a wide area has to be covered promptly.

The best results are obtained by unpoisoned pre-baiting—probably two applications, with a day interval between ; that is, pre-bait on the first and third days and poison bait on the fifth day.

National wheat flour, preferably with a maximum of 10 per cent. castor sugar added, is an admirable bait base and is particularly acceptable to rats. A dessert spoon attached to a stick about 2 ft. long is required to distribute the baits, and the whole infested area should be carefully and systematically treated, placing pre-baits in every hole and at covered points in haunts and runs used by rats, and where subsequently poison baits can be placed out of reach of live stock. Bread and biscuit meals, such as sausage rusks, are also suitable alternative bait bases which may be used wet or dry. Care should be taken when adding water to bread meals to mix to such a consistency that it remains crumby—not sticky or lumpy. Wet baits should be used the same day as mixed. To ensure uniform mixing the poison should be mixed with the meal before adding the water.

Arsenic, zinc phosphide or red squill in meal or other base baits are effective poisons. Red squill is the safest poison to use where there are poultry and live stock. War conditions have, of course, curtailed supplies and restricted the wide variety of materials which are otherwise suitable for baits—for example, fish, meat and fats.

The greatest care in the preparation and use of poison baits must always be taken to avoid all risk of other foodstuffs becoming contaminated and to prevent human beings and live stock having access to them. Thus meal baits should be placed out of the reach of stock and a careful check of the baits kept.

RAT DESTRUCTION

Rats are nocturnal in their habits. They sleep during the day and emerge at dusk to procure food and water. Invariably they use the same route to and from their haunts. It is better, therefore, to distribute poison baits during the afternoon and to complete distribution before dusk.

All work should be carried out quietly and with the least possible disturbance of existing conditions. Rats are cunning and intelligent ; they will sense immediately anything is made strange or unusual in their surroundings. Those which have taken a sub-lethal dose of poison may be suspicious for a long time afterwards. They will refuse to be tempted by the baits offered, and this bait prejudice or poison prejudice is the most usual cause of failure to obtain complete clearance in subsequent treatments. To surmount this all poison baits remaining after treatment should be cleared away, a fairly long interval should elapse before the next treatment, and for this and subsequent treatments both bait and poison should be changed.

Gassing Gassing is especially useful and effective on all outside infestations. It can be used as an alternative to poisoning, or as a second line of attack against rats which have survived the first treatment. When properly applied under suitable conditions gassing gives immediate results. It is a method which can be operated quite efficiently by anyone after very short training. The most important feature in all gassing operations is to make certain that the location harbouring the rats can be completely sealed off, so that the gas can be contained and the rats prevented from escaping. The most suitable places for treatment are hedgerows, holes in banks and outdoor burrows where a complete seal can be obtained on all holes.

Several gases can be used for rat destruction—hydrocyanic acid, carbon disulphide, sulphur dioxide, acetylene and carbon monoxide. Hydrocyanic acid gas is, however, the most easily applied, though the principle of administration varies little whatever type of gas is used.

Hydrocyanic acid gas is conveniently applied in the form of cyanide powder which gives off the gas on exposure to the moisture of the air or soil. Cyanide powder must not be used in buildings or places where live stock are housed, unless they can be removed for at least 48 hours and the building then thoroughly ventilated before readmitting the stock. Similarly, it must never be used in dwelling-houses, food stores or in hay and corn ricks, and never, in any circumstances, be brought into contact with foodstuffs. Neither should it be used during rain or when very high winds are blowing. The powder can be blown into burrows either with a pump or a dust gun, or one heaped teaspoonful inserted into each hole of the run.

Block All Holes The method of spoon gassing is to place a teaspoonful of cyanide powder 9 in. inside each hole. As each spoonful is put in, the hole must be securely blocked, taking care not to cover the powder with soil.

If turf sods are used for blocking—and it is better to do so—place the grass side inwards and stamp down firmly. The powder thus placed in the holes gives off gas and forms a gas pocket or chamber into which the rats come when attempting to emerge from the burrows. Thorough search must be made in the infested area to ensure that all holes are blocked to prevent

the inlet of air and the outlet of gas or rats. This procedure should be repeated at any re-opened holes at intervals of two or three days until all holes remain blocked after treatment.

PUMP GASSING Gassing by pump is very effective in light or loose soils. Particulars of the pump can be obtained from a chemist or from the makers and distributors of cyanide powder. The operator should first make himself fully conversant with the action of the pump and, having filled the chamber with powder, it should be tested to ensure that it is working properly before starting treatment. It is also a good plan to test from time to time during the gassing operations.

As with spooning, the holes on the site should be blocked a few days before gassing is commenced. At least two operators are necessary; one to work the pump and the other to block the holes. Starting from the windward end, insert the tube from the pump into one of the lower holes, making sure that the tube does not become blocked with soil and that the gas does not blow back when pumping. If this happens withdraw the tube and change to another hole. As gas is seen to emerge from open holes, block securely and continue the procedure until all holes have been gassed and blocked. Rats are very apt to bolt from burrows when pump gassing. An important advantage to be gained by pump gassing is that gas is forced to circulate through the burrow and as it emerges it reveals the holes and places to be sealed by blocking.

Trapping There are a large number of traps and trapping devices which can be used to destroy rats, but in general their degree of success depends more on the skill of the trapper than on the type of traps used. Invariably rats soon learn to avoid traps.

Proficiency can be attained under Guidance Rat destruction in any of its aspects is undoubtedly a craft, but this need not deter attempts by the inexperienced, since by observation, careful study, guidance and training, proficiency can be attained and successful results achieved. But action against rats must not be desultory: only by persistent effort can their numbers, once reduced, be kept under control. Remember, a few rats quickly become many. The real craftsman will, by his skill and dexterity, particularly with poison in the first instance, take considerable toll of serious infestations, and the greatest attention should always be given to his advice. The amateur, before using poison, should seek the advice of the expert, and to-day there are greater facilities than ever for all to be informed and assisted. Trained women, especially members of the Women's Land Army, have done remarkably good work in the rat destruction schemes being operated by War Agricultural Executive Committees.

In all efforts to destroy rats, every person in the district, parish or county should collaborate to deal with the rats on their own premises, for it is only by such co-operation that the rat menace will be effectively overcome.

FARMING NOTES

Breeding for Milk or Beef Of particular interest among a number of excellent articles in the most recent issue of *Agricultural Progress* (Vol. 19, Part 1), published by Messrs. Wilding & Son, Ltd., Shrewsbury, price 2s. 6d., is Dr. John Hammond's "Breeding of Cattle for Milk or Meat". "In this small country," says the author, "with its lack of large extensive-grazing areas and great demand for liquid milk, we can only hope to obtain a small proportion of our beef from pure beef breeds ; the bulk of our beef must be obtained from dual-purpose cattle, or from these crossed with a beef bull."

The Dairy Shorthorn is responsible for the greater part of our milk production, and during the past twenty years more and more attention has been given to developing the breed's milking qualities. The traditional methods employed by our farmers in breeding for beef are based on touch and experienced judgment, but this will not do where milk is the aim. Beef qualities are expressed in both bull and cow fairly equally ; the value of the bull in breeding for milk can be gauged only by noting the milk yields of his daughters. We need, therefore, a nucleus of proven bulls, and by mating them to high-yielding cows we can be assured that there will be milk on *both* sides of the pedigree. The use of proven bulls is of even greater importance for the breeding of bull calves than for the breeding of heifer calves. Dr. Hammond quotes an example from U.S.A., where in a recent study, 47 out of 49 sons of proven sires from high-yielding cows got high-producing stock.

"The danger of crossing dual-purpose cattle with a beef bull is that heifers from this cross may find their way into dairy herds, and so reduce the efficiency of the dairy industry. This danger can be overcome by using beef bulls which have a distinctive colour marking, such as the Hereford (white face) or Aberdeen Angus (black colour)."

Calf-rearing by Nurse Cows on an Arable Farm There is an increasing demand for store cattle suitable for fattening on leys or in yards on arable farms, and in this connexion Mr. H. Sainsbury, of Overton, Ross-on-Wye, has adopted the nurse-cow system of calf-rearing, which provides him with suitable stores for yard fattening and farmyard manure for his mainly arable farm.

He purchases fortnight-old calves suitable for fattening, and suckles them on a herd of eight non-pedigree nurse-cows which calve in the spring. Each cow suckles 3 to 5 calves per lactation, according to her milk yield, the aim being to allow each calf one gallon of milk daily for 5–6 weeks. Under this system there are three groups of calves, born in the spring, summer and early autumn respectively.

The spring and summer groups spend the first winter indoors, outwinter during the second, and are yard-fattened during the third. Forward animals may be fattened during the second winter. The autumn group spends the winter months indoors and are fattened during the third winter.

The calves are weaned at 5–6 weeks old, feeding consisting of calf nuts and an oat-pea-bean mixture *ad lib.* From weaning to six months they receive 3 lb. per day of dry food, consisting of 1 lb. dried beet pulp, 1 lb. calf nuts and 1 lb. oat-pea-bean mixture. Cattle wintered indoors receive straw chaff with wet pulp and one feed of hay per day (except younger cattle, which have two feeds of hay), and 2–3 lb. of the oat-pea-bean mixture, with straw *ad lib.* Outwintered cattle are fed whole mangolds, two-thirds

straw and one-third hay. Younger cattle have some pulp also. Fattening cattle have straw chaff, roots and pulp, with oat-pea-bean mixture from 5 lb., rising to 9 lb. per day with fodder, and they take four months to fatten.

Forty fat cattle were sold in the spring of this year, and 37 reached super-grade, the average live weight being: bullocks 13 cwt.; heifers 11 cwt.

Appointment of Committees on Agricultural Education The Minister of Agriculture and Fisheries and the President of the Board of Education have jointly appointed a Committee to advise them on all aspects of agricultural education to be provided by local education authorities and particularly on the educational policy and methods of training to be adopted at farm institutes. The Committee will be a permanent body and will advise the two Ministers on such matters within their terms of reference as they think fit and on any questions on agricultural education up to and including farm institute level that may be referred to them.

The Chairman of the Committee is Dr. Thomas Loveday, M.A., Vice-Chancellor of Bristol University, who was a member of Lord Justice Luxmoore's Committee on Post-war Agricultural Education, and is Chairman of the Ministry's war-time Committee on Higher Agricultural Education. The other members are:

Mr. F. Barraclough	Secretary to the North Riding of Yorkshire Education Committee.
Dr. J. Ewing	H.M. Inspector of Schools.
Mrs. F. C. Jenkins, C.B.E. ..	Assistant Director, Women's Land Army.
Mr. C. Bryner Jones, C.B., C.B.E.	Formerly Welsh Secretary of the Ministry of Agriculture.
Mr. L. R. Missen, M.C., M.A. ..	Director of Education for East Suffolk.
Mr. A. E. Monks, J.P.	An organizer of the National Union of Agricultural Workers, now serving as Labour Liaison Officer to the Minister.
Mr. W. A. Stewart, M.A. B.Sc. ..	County Agricultural Organizer and Principal of the Northamptonshire Institute of Agriculture.
Dr. G. K. Sutherland	H.M. Inspector of Schools.
Mr. R. A. Ward	Chairman of the Development and Education Committee of the National Farmers' Union.
Professor J. A. Scott Watson, M.C., M.A.	Sibthorpian Professor of Agriculture at Oxford.

The Minister of Agriculture has also appointed a Committee to consider the character and extent of the need for higher agricultural education in England and Wales and to make recommendations as to the facilities which should be provided to meet the need. This Committee will deal with agricultural education provided by agricultural colleges and university departments of agriculture and will take over the functions of the Ministry's war-time Committee on Higher Agricultural Education.

The Chairman is Dr. Loveday, and the other members are:

Mr. R. Beloe	Chief Education Officer for Surrey.
Mr. D. G. Brown, J.P.	Farmer and member of the war-time Committee on Higher Agricultural Education. Member of the Agricultural Improvement Council.
Mr. George Brown	An agricultural organizer of the Transport and General Workers' Union and member of the Hertfordshire War Agricultural Executive Committee.
Dr. Charles Crowther, M.A. ..	Principal of Harper Adams Agricultural College and Acting Director of the National Institute of Poultry Husbandry.

Sir Frank L. Engledow, C.M.G., M.A.	Professor of Agriculture at Cambridge, Member of the Agricultural Research Council.
Mr. C. Bryner Jones, C.B., C.B.E.	(also a member of the Joint Committee.)
Mr. T. Neame, M.A.	Horticulturist, Governor of Wye College. Member of Kent Agricultural Education Committee.
Professor E. J. Salisbury, C.B E., D.Sc., F.R.S.	Director of the Royal Botanic Gardens, Kew. Member of the Agricultural Research Council and of the University Grants Committee.
Dr. G. K. Sutherland	(also a member of the Joint Committee.)
Miss D. S. Tomkinson, O B.E., M.A., J.P.	Member of the Worcestershire County Council, member of the Executive Committee and Chairman of the Agricultural Sub-committee of the National Federation of Women's Institutes.
Mr. L. G. Troup, B.Sc.	County Agricultural Organizer for Hampshire and Executive Officer of the County War Agricultural Executive Committee.
Mr. J. Turner	Vice-President of the National Farmers' Union.

The Secretary of both Committees is Mr. F. L. Wormald, Ministry of Agriculture and Fisheries, Block 4 Bickenhall Mansions, London, W.1.

Transport for Harvest 1944 Plans have been made to meet transport difficulties in gathering this year's grain crops and conveying workers to and from the farms.

The larger acreage of crops to be harvested by combine this year, together with the greater call on road transport for military operations will mean more grain to be moved during the peak period with less transport to move it. It should not, therefore, be taken for granted that facilities will be available to convey grain to the mills immediately after threshing. Farmers who have no storage accommodation are advised to make certain before threshing, that transport facilities will be available to take their grain.

The plans involve the co-operation of the Ministry of War Transport, County War Agricultural Executive Committees, the Services, National Fire Service, Civil Defence and Local Authorities and, of course, the farmers and road hauliers themselves. First, the farmers must make the maximum use of their own transport and also help their neighbours. The concession made in last year's Finance Act enables farmers to use their tractors for carting their own and other farmers grain, and an Order has been made allowing "F" licensed lorries to be used in connexion with the harvesting of crops for neighbouring farmers between July 15 and November 30. The next approach should be to the local haulier ; failing him, to the Officer Commanding any Army (including Canadian and U.S.) or R.A.F. unit in the district. Although the amount of assistance available from this latter source will necessarily be on a reduced scale, help will be given whenever possible.

If the facilities from these sources are insufficient to meet the needs of any district, farmers should then approach the Sub-District Manager of the Ministry of War Transport, who can call on the N.F.S., Civil Defence and Local Authority to lend vehicles or arrange for assistance from other areas. Lists are being compiled of spare vehicle time from all sources which can be utilized for the harvest.

Arrangements have been made so that grain harvested by combine which is certified by an "approved buyer" as "potentially millable" may be transported as quickly as possible for treatment to render it suitable for milling into flour. The day-to-day operation of the scheme will be kept

under review by Regional Transport Committees of the Ministry of War Transport, who will have before them particulars of the grain coming forward, the maximum transit time which its condition will permit, and the transport facilities available.

To ease the burden which will be thrown on the already depleted public rail and road facilities for the conveyance of workers, an Order has been made relaxing restrictions on goods vehicles carrying workers out to the fields until the end of November. This will enable farmers and also commercial undertakings and public bodies to use their lorries to convey parties of workers to and from the farm. The vehicles must, of course, be properly insured for this purpose, and motor vehicle insurers have agreed to provide special cover. Business firms wishing to use their lorries in this way should notify the Sub-District Manager of the Ministry of War Transport, if possible two or three days beforehand, and at the same time apply for any additional petrol coupons required. In some districts private car owners are organizing volunteer car pools, in collaboration with the County Committee, for taking workers to farms over week-ends and during the evening. The scheme includes the transport of volunteers to agricultural camps, and County War Agricultural Executive Committees will work out with the Railway Companies the best arrangements for travel where difficulties are likely to be met. Where special arrangements are necessary, the volunteers will be notified immediately by the County War Agricultural Executive Committees as to how they should travel, and they should comply strictly with the advice given to them.

NOTICES OF BOOKS

The Living Soil. E. B. BALFOUR Faber & Faber. 1943. *12s. 6d.*

The theme of this book is what the author describes as the "Humus *v.* Chemicals controversy," though it is only fair to state that the controversy exists only in the minds of the humus partisans. They deprecate the use of inorganic fertilizers on the grounds that food so produced lacks the qualities necessary for the maintenance of animal health. This book purports to present the evidence that organically manured crops are qualitatively superior to those inorganically manured, but, on analysis, it is very slender. The author has written with obvious honesty of purpose; nevertheless, she unwittingly misleads the reader One chapter, for example, quotes extensively from the *Medical Testament*, a publication issued by the General Practitioners of Cheshire, wherein it is affirmed that the root cause of much of the nation's ill-health is faulty diet. This, of course, is an established fact, but it is a red herring drawn across the line of the book's main argument The doctors apparently refer to a *hypothesis* that organically manured food crops may be more health-promoting than inorganically manured, but they adduce no evidence to support it. In the context of the book the first impression which the reader receives is that a responsible medical body is using the fact of widespread malnutrition to advocate the exclusive use of organic manures for food production. This *Testament* is referred to frequently as evidence of the superiority of organic manure; but it is not evidence—it is purely unsupported opinion

In another chapter the remarkable health of the Hunza tribe in India, and of the inhabitants of parts of China, of the Faroe Islands and of Tristan da Cunha, is compared with the poorer health of communities using artificial fertilizers. Most of these people are practically isolated, and there are many other factors in civilized life besides artificial manures that may be responsible for differences in health standards.

Again, it is stated that wind erosion was very noticeable in 1942 on the sugar-beet lands of Lincoln, Norfolk and Suffolk, and that this crop is nearly always grown with large quantities of artificials The reader thus gets the impression that the use of artificials induces susceptibility to wind erosion, whereas there is no evidence whatsoever of a direct connexion. In point of fact, the worst eroding soils are the humus fen soils.

Following the precepts of Howard, Take-all disease of wheat is attributed to lack of soil aeration interfering with mycorrhizal development. It occurred, in the author's illustration, only on parts of a field that were liable to waterlogging. "So much," she says, "for the theory that the disease is air-borne." But the disease is *not* air-borne,

either in theory or in fact. The causative organism is a soil-borne fungus, *Ophiobolus graminis*, which is favoured by such conditions as the author describes. There is no need to introduce a mycorrhizal red herring !

These are only a few of the many examples of tendentious writing indicating that caution is needed in accepting the author's assertions at their face value. Nobody denies the vital rôle of humus in maintaining soil fertility, but to propound what is in effect a new theory of that rôle on negligible evidence, and to discard all that is known about the nature of humus that does not fit the theory, can have no scientific justification.

Positive evidence in support of the author's opinion is confined to the experience of a few schools where health is reported to have improved remarkably following a change-over from inorganically to organically manured food These cases deserve careful study, as also do reports from market-gardeners, that they get higher prices for organically manured produce. When all the trimmings have been removed there remains a case for investigation, and it is satisfactory to learn that the Haughley Research Trust has been established for this purpose. The Trust is farming some 200 acres, half with organic and half with inorganic manures, and proposes to feed quantitatively similar diets produced from the two areas to separate lots of animals, whose general condition of health will serve as an index to the nutritive quality of their food. The theory is not one that admits of easy proof, but the proposed scheme of experiment represents perhaps as good a start as could be made.

Health is an infinitely more intricate subject to investigate than disease, and its study is most practicable by integrating detailed individual work on specific pathological conditions. It looks as though even the Haughley Trust, inspired by a genuine enthusiasm for the study of whole health, must nevertheless first pay attention to disease. For the crucial point of its experiment is whether, and if so what kind of, ill-health appears in the animals fed off the artificially manured area If none appears the experiment will have failed

Food and the People. (Target for To-morrow, No 3). SIR JOHN BOYD ORR. The Pilot Press. 1943. 3*s* 6*d*.

Of all the plans that are likely to emerge from the welter of war to invest the peace with security and stability none will be of greater importance than that designed to guarantee the peoples of the world a high nutritional standard Since the beginning of the present century there has been a great advance in the science of nutrition, and although much of it has already been translated to human requirements, a great deal remains to be implemented once world agriculture gets into full and balanced production. As the author says, "There is no hope of reaching the target for health until food production has been geared up to consumption requirements" The corollary is a wide expansion in the world's agriculture, with particular emphasis upon the protective food crops. It follows logically that the prosperity of an expanding and efficient agriculture will in turn stimulate urban industry and promote both internal and international trade

The dominant note must therefore be international co-operation, directed by an International Food and Agricultural Committee, which, while having no executive control over national organizations, will supply information and guidance on the best methods of ensuring a sufficiency of the right kinds of food throughout the world "A well-fed world will be a prosperous world Conjuring wealth for oneself out of someone else's scarcity is a dangerous pursuit, for nations as for individuals "

This is the author's basic recommendation, from which he proceeds to suggest the kind of organization which might be devised in Britain to fit in with a world-wide scheme. A National Food Board which would be responsible for providing the national supplies of the main foodstuffs and ensuring sufficiency within the purchasing power of everybody, would exercise its functions through Commodity Marketing Boards By the establishment of food reservoirs, seasonal variations in supply could be regulated to an even flow at a static price to the consumer, while still maintaining a remunerative price to the producer.

We have become used to all kinds of "targets" during the war, but these are only the necessary prelude to the "targets" for to-morrow, when the regeneration of world prosperity and the establishment of a lasting peace must claim the same vigour and determination which the war years have compelled.

Crops and Cropping. H. I. MOORE. Allen & Unwin. 1943. 12*s*. 6*d*.

Dr. Moore is to be congratulated on the production of a most useful and comprehensive book concerning all the crops commonly grown on the farm and others now cultivated here and there in response to war-time needs. General advice is given regarding the preparation of the land, selection of varieties and the control of weeds, diseases and pests. One chapter deals with cropping problems in relation to the

ploughing up of grassland, and the reconciliation of animal and human food requirements. The book also contains a number of useful Tables designed to assist farmers in diagnosing the commoner ills of plants, in planning a succession of catch crops, and in making the best use of the present restricted supplies of fertilizers.

Profusely illustrated with excellent photographs, this book is a welcome addition to farming literature.

Festgabe zum Siebzigsten Geburtstag von Prof. Dr. A.Volkart. Berichte der Schweizerischen Botanischen Gesellschaft, Band 53A. 1943.

This volume, issued as a special volume of the Reports of the Swiss Botanical Society, is dedicated to Dr. Albert Volkart, the celebrated Swiss agriculturist, and was presented to him on his seventieth birthday by his colleagues, pupils, and friends as a testimony to his outstanding success as a teacher and to his contribution to the development of agriculture in Switzerland.

Dr. Volkart was born in Hombrechtikon in 1873. After graduation in 1894 he entered the Seed Testing Institute at Zurich, where he was destined to work for the next 35 years. At first he was mainly occupied with seed testing and the study of alpine meadows and pastures Later, after the Zurich Institute had become attached to the Swiss Agricultural Department, he turned his attention more to plant diseases and cereal breeding. He rendered great service to agricultural societies, and during the 1914–18 war he was in charge of the country's food production campaign. In 1920 he became Director of the new State Agricultural Research Station, created by the amalgamation of his Institute with that for Agricultural Chemistry. The wide experience he had thus gained provided a solid foundation for his essentially practical teaching when, in 1923, he succeeded to the Professorship of Agriculture at the Federal Polytechnic College at Zurich.

The thirty or so papers included in the volume fully reflect Dr. Volkart's wide interests and those of the many students whose work he has directed. Three of the papers are in French, the rest in German, and they are grouped into seven sections. The first section contains eight articles of general interest, dealing, *inter alia*, with the history and aims of Swiss agriculture, the development of potato and seed production in Switzerland, the significance of clover pastures, and the need for ensuring the marketing of cereal grain through an international organization. The other articles are more specialized and include, for example, the results of investigations into specific problems related to soils and manuring, cereal cultivation, forage crops, and pests and diseases

Combine Harvesting in the North—1943. National Institute of Agricultural Engineering. 1944. 6d.

During the 1943 harvest the National Institute of Agricultural Engineering studied combine harvesting on farms in Yorkshire and Lincolnshire. The performance of some thirteen different models was studied in especial relation to the generally less favourable conditions obtaining in the North. Combine owners in Northumberland and Scotland were also visited, and the present booklet sets out very clearly the results of the investigation. Laid crops and rainy weather delayed harvesting appreciably in the North last year, but farmers using combine harvesters appear to have suffered less damage to their crops than those using other methods. There is some interesting information on factors affecting the performance of combines, and on the varieties of grain most suitable for combining; short stiff-strawed cereals, standing well, simplify the job considerably. A combine fitted with a pick-up attachment successfully dealt with peas first mown in the usual way. The comments on individual combines and a tabular comparison of performance is just the kind of information which the potential combine owner wants to know. Altogether, this is an extremely useful and interesting publication.

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THE AMERICAN FARMER

PROFESSOR J. A. SCOTT WATSON, M.A.

THIS is an attempt to analyse the American farmer's outlook on public affairs and to interpret it in the light of his traditions, his war-time experience, and his expectations about the post-war period.

Who are America's Farmers ? Americans commonly include as "farmers" the whole agricultural class, numbering over six million families and thus constituting nearly a quarter of the population. It is in fact impossible, in America, to draw the distinction between farm workers and farmers that is commonly made in Britain. Neither is there, except here and there, anything that can be called a "landlord class". Only a very small proportion of America's farms are large in the sense that many hands are employed. A survey covering 1929 showed that 58 per cent. of "farm operators" (farmers in the British sense) employed no hired labour, and that great numbers of the remainder either resorted to the labour market only at harvest or other peak periods, or else employed only one hired man. Indeed, in some areas, particularly of the South, the family farms are less than the economic size—that is, too small to provide full employment even for one man.

Something over half the farms of the country are owned by their occupiers, but many carry mortgages; in many cases the mortgage is so heavy that in periods of depression ownership has become almost nominal, that is, interest payments have been about as high as the rentable value.

Next is a numerous class of tenants with some considerable capital, who pay rents, partly in cash but more largely as crop shares, to landowners who may be city investors, small-town business or professional men, retired farmers, banks, insurance companies, etc. In general, tenants have little security of tenure, and there is very little in the way of custom or law in regard to tenant right or improvements.

Lower down the scale come regularly hired men and share-croppers. The former are paid partly in cash and partly in fixed perquisites; the latter in the form of an agreed share of the farm produce. The share-cropper has little or no capital. In general, the hired man has the better income and the greater degree of economic security. Many croppers are chronically in debt to their landowners.

At the bottom is the class of casual workers—partly migrants. For a considerable number of years before 1940 the supply of such labour was much in excess of the demand. Hourly wages or piece-work rates were not, perhaps, unduly low, but living conditions were usually primitive, while long periods of unemployment and long journeys between jobs left the workers with low net earnings.

American farming has retained a strong element of subsistence production. A recent survey shows that about 60 per cent. of the food of all farm families was produced on their home farms.

While all "farmers" naturally wish for prosperous conditions in agriculture, it would be quite unrealistic to expect closely similar viewpoints on particular matters to prevail throughout all strata of the farm population.

Farming Tradition We may broadly distinguish three areas in regard to farmers' backgrounds and traditions.

The North Atlantic and Middle Atlantic States are old-settled country, and their rural families are largely those who did not "go West". These States contain the oldest of the great cities, and their farmers have never depended largely upon overseas markets. The area suffered in the 'eighties and 'nineties (as Britain did) from the competition of the West, and its farmers, like their opposite numbers in Britain, were obliged largely to give up commercial grain production. However, the growth of nearby city markets for milk, poultry, eggs and vegetables enabled appropriate changes to be made in the structure of their farming. Some of these changes were painful. Moreover, a good many of the poorer hill farms became sub-marginal and were abandoned, their owners migrating to the West or to the cities. In general, the farming methods that were brought from Europe proved well enough adapted to the local conditions, and there has been no wholesale destruction of originally fertile land. Since the States in question are mostly wealthy (owing to their large urban industries), they have been able to provide very good educational facilities, even in their rural areas.

The farmers may be generally described as thrifty, industrious and conservative; the level of mortgage indebtedness is exceptionally low and tenancy is uncommon. The extreme types are found among the Pennsylvania Germans. These people are deeply attached to their farms, take good care of their soil, live very frugally and spend nothing on such "vanities" as motor cars and cinemas. They keep out of debt and they

dislike change. Moreover, they did not fall into real destitution during the depression of the early 'thirties and they were not particularly in need of the measures of agricultural adjustment or of the payments and credits that were provided under the Agricultural "New Deal".

The South-east (except Florida) has, of course, long been the problem area of rural America. Among reasons adduced for the area's economic backwardness are the emancipation of the slaves, the widespread devastation that occurred during the civil war, and the refusal of the North to aid in the work of rehabilitation after that war. But probably more important, as a root cause of the South's rural poverty, has been the widespread destruction of its soil. This is the result of the general adoption of cropping schemes that were quite inappropriate to the climatic and soil conditions. In any case there has long been excessive pressure of rural populations on the remaining area of farm land, and poverty has long been more or less severe. Among its direct and indirect consequences have been malnutrition, bad housing, inadequate sanitation and poor educational and medical services, and these have resulted in widespread ill-health and a condition of extreme economic insecurity. Such long-continued influences have bred in the farming communities a certain degree of thriftlessness and fatalism—for instance, profits, in good years, tend to be squandered. The rate of increase of population has remained high, and, since the people are ill-fitted to compete for employment in the industrial areas of the country, migration from the South has been too small. The Southern negro especially, when he seeks employment elsewhere, is "the last hired and the first fired".

The remainder, and by far the greater part, of rural America has a very different tradition. In colonial times and in the early days of the Republic the vast majority of American citizens were farmers, and they were regarded, and regarded themselves, as the backbone of the nation. Jefferson wrote:

> Those who labour in the earth are the chosen people of God—if ever He had a chosen people—whose breasts He has made His peculiar deposit for substantial and genuine virtue. Corruption of morals in the mass of cultivators is a phenomenon of which no age or nation has furnished an example

Despite the fact that America has become a highly industrialized country, something of this attitude remains. Farming, according to American farmers, is still the natural and the good life, while the factory and the city are full of corrupting influences. The persistence of this attitude in its more extreme form may perhaps be explained by the remoteness of so many of America's farms from centres of industry.

Again, the settlement of the West called for qualities of courage and self-reliance, for immense physical effort and for the capacity to withstand hardship and privation. Accordingly the western farmer still likes to be thought a "rugged individualist"; he takes pride in his versatile skill, and he claims that he is still capable, when necessary, of heavy toil and long hours of labour. He likes to think of himself as sharing the economic independence, and the ability to take care of himself, of his settler grandfather.

Thirdly, it was long true that a good average American could make his way in the world as a farmer. For many years land was cheap or free, and the capital needs of farming were small. A young man, after a few years of apprenticeship and saving, could acquire or create a farm of his own. Even after the supply of virgin land gave out, as it did fifty years ago, it was still possible to climb the agricultural ladder—from hired man to tenant and from tenant to owner. Ownership was always the ultimate goal, and the elderly man who remained a labourer or a tenant came to be

regarded as a failure. Another fact is that the farmer became accustomed to the idea of consistently rising land values. When he had acquired a farm and paid off his debt he was assured of a competence for his old age. This state of affairs persisted, in the main, until 1920, and it is still the state of affairs that, in the farmer's view, would prevail if only agriculture could obtain economic security.

From about 1870 onwards the farmer began to lose his economic independence. If he was to keep abreast of other people in regard to material wealth, he had to forsake his old self-sufficient economy. To make money he had to sell produce ; and farming for money resulted in specialization. For the marketing of this produce the farmer depended upon railways and traders. To produce for sale he needed factory-made machines, and so became dependent on the manufacturer. Often he had to borrow money to buy these machines, and became dependent on his banker. As land values rose the tenant had generally to arrange for a mortgage before he could buy a farm. Again, the farmer naturally became concerned about the price of the produce he had to sell, and hence developed an interest in currency questions. Thus it happened that the early efforts of American farmers to take organized collective action were aimed at securing fair terms from the people on whom they depended. The original objective of the "Granger Movement" was to secure equitable railway rates, and the next, by setting up co-operative societies, was to bring to reason the traders and manufacturers who were making unreasonable profits at the farmers' expense. The "Greenback Movement" after the Civil War was intended to prevent deflation and a fall in prices. The Populist party of the 'nineties was essentially a combination of the agrarian and labour interests against big business and high finance. From the end of the century until the end of the first World War, commodity prices and land values rose, and farming prospered. The five years 1910–14 have been accepted as a base period for price "parity" calculations—that is, as a period when the farmer received a fair reward for his services or his "just share of the national income".

Farming between the Wars. The latter part of the first World War brought both an unprecedented demand for American produce and an extreme inflationary movement. Productive capacity was considerably expanded, both by breaking up new land and by more intensive cultivation achieved largely by means of tractors and additional machines. In the period 1917–20 farmers generally came to expect a long-continued and keen export demand for farm products, and this expectation was reflected in a great boom in land values. There was a sudden collapse in 1920, and despite high business activity in the later 'twenties, there was little recovery in farm prices. There seems to have been no realization at the time that the fall in exports and the piling-up of surplus farm products was particularly related to American foreign trade policy. "Farmers and non-farmers alike were slow to realize that an effective market is not created by the desires or needs of men or of nations, but by their ability to pay with goods, gold, services or credit".* At any rate the United States continued to claim interest on her foreign loans, continued to exclude foreign goods by high tariffs, and continued to expect to sell farm produce to her debtors.

* Chester C. Davis ; Development of Agricultural Policy since the end of the World War. *United States Department of Agriculture Yearbook*, 1940.

Whatever other causes may have operated, there is no doubt that from 1920 onwards the economic position of farmers in America, *vis-à-vis* other groups, deteriorated greatly, and failed to improve materially until 1941. This is shown in the following Table:

	Average Net Income per person employed in Agriculture	Wage Income per employed Industrial Worker	Average Farm Income as Percentage of Industrial Income
	Dollars per Year	*Dollars per Year*	
1910–14 ..	366	582	63
1915–19 ..	677	877	76
1920–29 ..	585	1,295	45
1930–39 ..	428	1,093	39
1940 ..	526	1,273	41
1941 ..	726	1,495	49
1942 ..	1,062	1,847	57
1943* ..	1,392	2,138	65

* Preliminary estimate.

Among other useful measures relating to farm prosperity or depression are: (1) changes in the value of farm land; (2) the number of farm mortgage foreclosures in relation to the total number of farms; and (3) the "parity" ratio—that is, the ratio between the prices received by farmers for what they sell, and the prices (including interest and taxes) paid by farmers for what they buy. Parity is calculated on the base period 1910–14 when, as has been officially agreed, the farmer was receiving something like his fair share of the national income. Parity has been calculated only from 1925.

Land that had been worth £20 per acre in 1910–14 reached a market value of £34 in 1920 and fell to £14 10s. in 1933. Between 1920 and 1939 mortgage foreclosures occurred on more than one-third of all the farms in the country, which fact alone indicates a great change in the farmers' prospects; the "agricultural ladder" up which so many American farmers had climbed in the years before 1920 was afterwards to lead a great many downwards—in not a few cases all the way down from substantial occupying ownership to the status of tramp labourer.

Further evidence is to be found in the total amount of farm mortgage debt. The index (1910–14 = 100) rose to 234 in 1923–24, and was still as high as 179 in 1942.

Among the consequences of agricultural depression was a deterioration of public services, and particularly of education, in those States where agriculture is the chief industry.

One other feature of the years between the wars, which may be partly a cause and partly a consequence of agricultural depression, was the slowing down of the normal migration of farm youth to the cities. In the late 'thirties it was estimated that two million young people, surplus to the needs of the agricultural industry, were "backed up" on farms. This phenomenon seems to have arisen partly out of the growing educational handicaps of country-bred children. In some part it may be related to the increasing practice of stressing vocational agricultural education in rural high schools. Again, it may, in some measure, have been due to the rapid development of mass-production methods in industry, which at times threw out of employment skilled and trained industrialists with whom rural youths could not compete in their search for urban employment. Meanwhile, of course, the creation of new farms had practically ceased,

some farms had been abandoned owing to soil exhaustion or erosion, and farm labour requirements had been steadily reduced by the increased use of tractors, combine harvesters, maize-pickers and other labour-saving machines. Owing to the over-supply of farm labour, the discrepancy between farm and factory wages greatly increased. Thus in 1925 the hourly earnings of factory workers were three times as high as they had been in 1910–14, while farm wages had risen only 25 per cent.

The following statements were made by a leading agricultural economist* with reference to the year 1935–36, when there had already been considerable recovery from the depths of depression in 1932–33.

(1) An annual income of about $750 was necessary to supply the minimum physical and cultural requirements of a typical rural family of two adults and three children ; 40 per cent. of all farm families had less than this amount, and 1,600,000 (or nearly 25 per cent.) had incomes of less than $500.

(2) The 25 per cent. of American families who lived on farms, and to whom belonged 31 per cent. of all children of school age, received about 9 per cent. of the national income.

The conditions under which the farmer lived between 1920 and 1940 may therefore be held largely responsible for his present outlook. His predominant feeling is that he has been, for these twenty years, the victim of grievous economic and social injustice. It is true that there has lately been a marked change in the farmer's financial position. Farm prices rose slightly above "parity" in 1942, and were 16 per cent. above parity in 1943. Moreover, net farm incomes for 1943 were about three times as high as those of the last pre-war years. But two years of good profits have not made up for twenty-two years of poverty.

Since his own rewards have been small, the farmer naturally asks himself who has been gaining at his expense. He can no longer blame his old enemies, the railways, the land speculators, the banks and loan companies, for all of these, in varying degrees, have been his companions in distress. He cannot logically blame those who trade in his produce as wholesalers, for he has the option of marketing through his own co-operatives. He does not specially blame the farm machinery manufacturers who, although they have sometimes tempted him into uneconomic investments and unwise debts, have made notable improvements in his tools and have, by developing mass-production techniques, been able to sell efficient machines at progressively cheaper prices. Moreover, there are at least half a dozen large and efficient equipment companies in constant competition for the farmer's business. On the other hand, he has evidence, some of which has been given above, that urban industrialists and retail traders, and particularly the organized industrial workers, have been doing well whilst he has been faring very ill. Probably he makes too little allowance for urban costs of living and the incidence of industrial unemployment. In varying degrees he blames trade unions for their methods of securing unduly high wages, and the Government for allowing these methods to be used. He feels that the only means open to him, by which he can hope to attain and maintain the economic position that is his due, is to exert political pressure through his organizations—i.e., to maintain a strong "farm lobby" in Washington. The sympathy shown towards industrial labour by the leaders of the Farmers' Union (which is one of the three leading organizations of farmers) does not reflect the feelings of farmers as a whole.

* O. V. Wells, Head Agricultural Economist, Bureau of Agricultural Economics. *U.S. Dept. of Agriculture Yearbook*, 1940, 388-9.

(3) The attitude of farmers to the "New Deal" has been undergoing change during the past two years. It seems that up to 1941 a large majority would have agreed that the various measures making up the "Agricultural New Deal" materially helped to shelter them from the economic blizzard, and to make their lot more tolerable. The Soil Conservation Service and the Rural Electrification Administration have admittedly done much good. The great majority of farmers co-operated under the Agricultural Adjustment Programs, and the Commodity Credit loans to which they thus became entitled served to stabilize the prices of five commodities—maize, wheat, cotton, tobacco and rice—at levels that were not ruinous. Moreover, "parity" payments were made to farmers who were prepared to bear their share of necessary restriction of output. The Farm Security Administration was frequently subjected to the criticism that it was "pensioning" farmers on sub-marginal farms and thus preventing the free play of economic forces. It was unpopular with the Farm Bureau and the Grange, but, naturally, was strongly supported by the Union. It seems undeniable that large numbers of the deserving poor, who were "down but not quite out," have been helped by the F.S.A. to re-establish themselves, and at a relatively small cost to the country.

Gratitude for benefits received was always tempered by a certain amount of resentment against the necessary formalities and supervision of the New Deal Agencies ; by a feeling of something like shame in having to accept "doles" ; and by a kind of instinctive belief that the whole bundle of New Deal measures should never have been required. Co-operation between the Federal Action Agencies and the State Land Grant Colleges has been variable, and in some States is still not good. Some college men feel that they could have carried out the necessary work of adjustment more efficiently and with less duplication of services. Others take the view that the Federal Action Agencies constitute one of the many undesirable encroachments of the Central Government upon State rights.

War-time Problems : LABOUR

Long accustomed to a heavy over-supply of man-power, the American farmer naturally found difficulty in adjusting himself to a condition of labour scarcity. In 1942, there was deep resentment at the calling up of key farm workers, at a time when farmers were being unceasingly urged to increase production. The chief real sufferers were : (1) cattle and sheep ranchers, who employed, almost exclusively, young, fit and unmarried men ; (2) milk producers in industrial areas, who suffered a double loss to the Forces and the war factories, and who had, in the main, to make shift with a considerable proportion of unskilled workers : and (3) growers of sugar beet, fruit, potatoes and vegetables, whose casual labour rapidly drifted away into war industries.

(The South-east continued to have a surplus of farm workers while there was acute scarcity elsewhere, and under-employment still persists in that area to-day. The unfamiliarity of Southern farm people with machines and with up-to-date methods of livestock management has made for difficulty in redistributing the available man-power.)

(Employers of casual workers have had to make do with school children, students, vacation workers and other volunteers, and costs of their operations have considerably increased.) Perhaps beet-growers have encountered the greatest difficulties, since their harvest falls in the late autumn and the

work, in any case, is beyond the endurance of most city workers. Some lasting harm has been done—losses of sheep have been considerable, and many ranchers have felt obliged to reduce their flocks; sugar-beet production has declined; wastage of dairy cattle has increased. In general, however, the plan of deferring essential agricultural workers has worked well and complaints have become comparatively rare. Supplies of farm equipment, which were very much restricted for a time, have lately improved.

FARMERS' PRICES It may be worth while to give some idea of the current prices of agricultural commodities expressed in our units and currency. In September, 1944, Chicago prices were: wheat 14s. 4d. per cwt.; oats 12s. 6d. per cwt.; maize 11s. 8d. per cwt.; fat pigs 18s. per score; prime fat cattle 80s. per cwt. Prices are naturally higher in seaboard markets—for example, grain is about 2s. per cwt. higher in New York than in Chicago.

The Agricultural Index (1910–14=100) has recently stood at about 190, but the index of agricultural wages has been about 260, and that of agricultural requirements about 165. As already indicated, the parity calculation suggests that the farmer is now about sixteen per cent. better off, by comparison with the rest of the community, than he was in the period 1910–14.

American farmers, like others, are rarely prepared to admit publicly that prices are good enough; but the consensus of opinion is roughly: (1) that the general level of agricultural prices is very satisfactory and that, with two successive good harvests, farmers have made excellent incomes; (2) that the price of milk, even with the addition of recent subsidies, is too low in relation to wages and feedingstuff costs—and, at any rate, gives the producer a poor reward for his work and worry, compared with the profits being earned by producers of most other commodities; and (3) that there has been a serious maladjustment between the prices of grain (especially of maize) on the one hand and those of pigs and poultry on the other. Either grain prices have been too low or pig and poultry prices have been too high. The maladjustment has been the main cause of the anxious situation that is dealt with below.

LIVE STOCK AND FEEDINGSTUFFS In 1941 it appeared that reserves of maize and other grains were so large, and possibilities of exports so remote, that it would be well to encourage livestock expansion and so provide more livestock products for export to the Allies. Accordingly livestock prices were allowed to rise, and farmers were given high "goals" for livestock products; but record industrial employment, at record wages, increased the domestic demand to an extent that had not been foreseen. Rationing of meat was introduced too late, was at first ineffective, and incidentally had the effect of diverting demand to unrationed substitutes, including poultry and eggs. The great expansion is shown in the following Table:

Numbers of Cattle, Pigs, Poultry and Eggs in U.S.A., 1940-43

	All Cattle on Farms at January 1 (*millions*)	Numbers of Pigs Reared (*millions*)	Chickens (*thousand million pounds*)	Eggs Produced (*thousand million dozens*)
1940 ..	68.2	79.8	2.2	3.5
1941 ..	71.5	84.7	2.4	3.5
1942 ..	75.2	104.7	2.7	4.0
1943 ..	78.2	127.0	3.5	4.5
1944 ..	80.6			

This expansion of livestock numbers was accompanied, in 1942, by a rather extravagant use of grain. In 1932, when grain was abundant and almost unsaleable, consumption per "animal unit" reached the record level of 1,700 lb. per annum; in the drought year 1934, it fell to 1,320 lb.; the figure for 1941 was 1,820 lb. and for 1942, 1,960 lb. The end result is a present shortage of feedingstuffs.

To meet the emergency the War Food Administration released, for feeding, large quantities of wheat which it held under Commodity Credit loans. It has imported all the Canadian grain, including wheat, for which it could arrange transport, and it was expected that as much as 390 million bushels of wheat would be fed in the year 1943–44. The War Food Administration is trying to secure considerable imports of oilcakes, of which commodity the country used to be a considerable net exporter. The W.F.A. is also taking control of a proportion of all home-produced oilseed residues, and is directing these to areas where supplies are short.

Numerous difficulties have resulted. Last winter range cattle-owners were unable to lay by the normal quantities of feed to provide against the risk of frozen snow-cover on winter pastures. Dairy and poultry farmers in the East and on the Pacific Coast have at times been short of the feedingstuffs they required. At times there has been great congestion of slaughter facilities, especially for pigs, and animals have been held up on farms after they had reached full marketable condition.

Steps have now been taken to bring the situation into balance—for example, the "ceiling" price of maize has been raised and the guaranteed price for fat pigs will be reduced as from October, 1944. Production goals have been lowered, and there is evidence that pig production is already being curtailed. Hatchery owners have accepted a scheme of voluntary restriction of their operations.

In the spring of this year there was deep anxiety about the outlook for feedingstuffs. Despite immense crops of feed grains in 1942 and 1943 (154 and 147 million tons respectively), consumption during the two years had greatly exceeded production, and it was clear that the once large reserves would be virtually exhausted by the autumn; moreover, there was no assurance that the wished-for reduction in livestock numbers would actually take place. Obviously a drought such as occurred in 1934 or 1936, when production fell below half the foregoing figures (69 and 74 million tons), would have brought about a major disaster. But, by something like a miracle, two remarkably good seasons have been followed by a third. Maize promises to yield within 5 per cent. of last year's great crop, and other grains are estimated to have produced 12 per cent. more than the very satisfactory yield of 1943.

The Outlook for after the War: INFLATION

British farmers, as is well known, have prospered in periods of rising prices and have suffered in times of falling prices. This has happened because changes in wages and rents have always lagged behind changes in commodity prices. The same is true, but in less measure, of American farmers; the differences being that a much larger proportion of American farmers pay neither rent nor wages, and that tenants pay large parts of

their rents in kind. But, again, one considerable group of American farmers—the owners of heavily mortgaged farms—are in an exceptional position. They are able to take advantage of a temporary wave of inflation and of high farm prices to redeem their mortgages in depreciated currency. Many are already using their surplus profits to redeem long-term debt. Incidentally, this represents a difference in attitude as compared with that of the First World War. Between 1914 and 1919 the index of farm mortgage debt per acre (1910–14=100) rose from 118 to 171, whereas the index has fallen somewhat since 1939—from 186 to 179. This suggests that farmers do not expect the present high price levels to be maintained for any great length of time—an attitude that contrasts with that which prevailed in the latter part of the first world war.

There has, of course, already been a considerable inflationary movement, wholesale prices of all commodities having risen by about 33 per cent. since 1939.

American farmers are interested in, and often discuss, inflation. Do they want a further rise in price levels, or do they consider that the movement has gone far enough and that steps should be taken to bring it to a halt ? Views differ.

One view in which farmers are virtually unanimous is that they do not want speculation in land. City investors are indeed already buying farms with the idea of "hedging" against inflation, and in cases where the buyer intends a permanent investment the farmer has no particular objection. But he has excellent historical reasons for fearing and hating the land speculator. Secretary Wickard has lately proposed, as a check on speculation, a graduated tax on all profits arising from dealings in land, the rate of tax to vary inversely with the length of time elapsing between purchase and sale. His proposed tax would certainly discourage speculation for quick profits, and especially, would prevent dealings in farm options, which reached a large volume in 1919–20. The proposal is being well received by farmers.

Will Farmers need the New Deal ?—The sickness of American agriculture in the years between the wars is attributed by most farmers to the loss of their overseas markets. The measures taken under the New Deal, even including the often criticized slaughter of young pigs, were necessary, in their view, to rid markets of burdensome surpluses. But will American farmers want overseas markets in future ? They note that their own intensive efforts, favoured by two exceptionally bountiful seasons, have raised the volume of agricultural production to a level that is fully 30 per cent. higher than that of 1932–33. In 1932–33 there were unmanageable surpluses. Maize was 1s. 9d. per cwt. and pigs were 2s. 6d. a score ; but to-day there is a great pressure of unsatisfied demand.

The great majority of farmers expect that farm prices will fall considerably about two years after peace, that considerable readjustment of farm production will be necessary, and that the problem of farm surpluses will arise again. They therefore believe that the majority of the "Action Agencies" set up under the New Deal should be kept in being, modified perhaps in the direction of more democratic control and less bureaucracy. Moreover, there is a growing feeling that international co-operation in regard to problems of food and agriculture might bring direct benefits to American farmers as well as do something for world well-being and world peace.

AUTUMN APPLICATION OF NITROGENOUS FERTILIZERS TO CEREALS

SIR E. JOHN RUSSELL, O.B.E., D.Sc., F.R.S.

FORMERLY it was the practice to apply sulphate of ammonia to wheat in the autumn in the expectation that it would promote good root development during the winter and generally help the young plants to establish themselves. This was the procedure adopted with the Rothamsted experiments. But when analysis of the drainage waters from the Rothamsted soil showed the very heavy losses of nitrate from the soil during the winter months, a new plan had to be tried. Lawes used to say that enough nitrate was washed out from the bare soil of the drain gauges in winter to produce a four-quarter crop of wheat ; and he disliked these heavy losses.

Rothamsted Experiments From 1879 onwards, therefore, sulphate of ammonia was, at Rothamsted, applied in spring, the only exception being that a part of the dressing might be, and on the Broadbalk plots was, given in autumn to help the plant make a start. Objection to the autumn dressings was also taken on the grounds that they tended to bring the wheat on too quickly, so that it became liable to frost damage and other troubles associated with the "winter-proud" condition. Spring dressings thereupon became the normal agricultural practice.

In order to make the comparison between spring and autumn dressings, one of the Broadbalk plots continued to receive its full dressing of sulphate of ammonia in autumn, while another, equally treated in all other ways, received most of its dressing in spring. On the average the autumn application has proved the less satisfactory, having given just under 2 cwt. per acre less grain and 4 cwt. per acre less straw than the spring dressing. This reduction of yield corresponds on the Broadbalk field to a dressing of 16 lb. nitrogen per acre, indicating that nearly ¾ cwt. sulphate of ammonia has been lost during the winter ; a loss of nitrogen which, while less than the loss from the bare soil of the drain gauges (40 lb. nitrogen), is still sufficiently serious.

Lawes and Gilbert never discussed the results of this experiment, but Sir Daniel Hall, who later summarized the Rothamsted work, pointed out that the loss of crop from the autumn application of sulphate of ammonia was less in dry winters than in wet ones, and in the revised summary of the Rothamsted experiments, published in 1919, he and the writer showed that in the years of low winter rainfall (October to March) the loss was only 0.7 bushels of grain per acre, or 2.2 per cent. of the crop, while in the years of high winter rainfall the loss was 5 bushels per acre, 18.1 per cent. of the total crop. Later, when statistical methods became available, it was shown that high rainfall in spring and summer is even more harmful to the yield on the autumn-dressed plot than is winter rainfall. The investigation was made by a distinguished and highly competent statistician who preferred to remain anonymous under the name "Alumnus". He showed that October rainfall acted similarly whether sulphate of ammonia was applied in autumn or spring, but that rain falling in later months had a worse effect on the plot receiving the autumn dressing, and that this became more pronounced as the winter advanced, reaching, in

February, a high level which was maintained during the months of March, April, May and June. During these months the effect of one additional inch of rain was to widen the difference between the autumn and spring dressings by just about one bushel per acre.

Woburn and Cambridge Experiments Various other experiments have been made on the same subject, but unfortunately not many. They all, however, led to the same result. In three experiments at Woburn during the years 1934 to 1936, the spring dressings gave on the average an additional 1.2 bushels of wheat per acre over the autumn dressings of the same quantity of sulphate of ammonia. Imperial Chemical Industries organized experiments at five centres in 1935; in these, the spring dressings gave 2 bushels per acre of wheat more than the autumn dressings. In three experiments at Cambridge, between 1933 and 1935, the advantage was also with the spring dressing, though the difference was less than at some of the other centres. In all these cases the average results are quite clear: spring dressing is more effective than autumn dressing.

It does not appear that the autumn dressing with sulphate of ammonia helps the young plant to tide over unfavourable weather. The numbers of plants on the experimental plots have been counted, and there was no evidence that a nitrogenous dressing led to any numerical increase, whether it was given in autumn or in spring.

Autumn Dressings may be Justified in Certain Cases However, there are exceptions. In a few cases the autumn application was not inferior in effectiveness to the spring application, but was even superior to it. This usually happened in dry winters and, while it is sufficiently uncommon not to affect the general rule, the fact that it occurs at all has been taken as justifying autumn dressings in special cases. In the early days of the last war it became necessary to encourage the use of sulphate of ammonia in preference to nitrate of soda, then the more usual nitrogenous fertilizer, but owing to storage difficulties it was necessary to get the fertilizer out on to the farms during the autumn instead of allowing it to accumulate at the works and storage depots throughout the winter, as had previously been the custom. Farmers were therefore urged to buy sulphate of ammonia during the autumn of 1915 and to put it on to their wheat: Sir Thomas Middleton estimated that some 75,000 acres of wheat were so treated. Prior to the war the bulk of the sulphate of ammonia made in this country had been exported, but that trade was cut off and so we had abundant supplies at the time; it was felt justifiable to take the chance that conditions might be favourable to good effects of autumn dressings, especially in view of the urgent need for wheat and the shortage of storage capacity on farms. It is not possible to say how far this recommendation to apply sulphate of ammonia in autumn was justified by the results because no adequate number of trustworthy measurements could be made. The general recommendation to use sulphate of ammonia as fertilizer was promptly adopted, and consumption rose from 50,000 or 60,000 tons per annum before the war to about 230,000 tons in 1918. The popularity of sulphate of ammonia has survived the last war, but the suggestion that it should be applied to cereals in autumn has not been generally adopted.

Spring Dressings usually More Efficient The conclusion that can safely be drawn is that spring application of sulphate of ammonia to cereals is more efficient than autumn application, and this latter can be recommended only in special circumstances. The difference in effectiveness is less in dry seasons than in wet ones and if, for reasons of transport or of storage it is important to get the sulphate of ammonia on to the farms in early autumn, and if there is no good storage on the farm and sulphate of ammonia is sufficiently abundant to justify risk of loss, then it may be legitimate to take the chance of a dry season and apply it to wheat in early winter.

Early or Late Spring Dressings? The position is entirely different in regard to the question whether the spring dressing should be given early or late. Should the sulphate of ammonia be applied directly growth begins in the spring, or should the application be delayed till the rapid flush of growth in May? Experiments on this subject have been made at various centres, and they have shown that on the average, so far as grain is concerned, it does not matter whether the nitrogen is given early or late, but that the straw responds less to late than to early dressings. A dressing which applied in March gave an additional 3–4 cwt. of grain and 10 cwt. straw per acre gave, when applied at the end of May, about the same quantity of grain but only 4–5 cwt. of additional straw. Where, therefore, there is fear that a nitrogenous dressing may cause lodging, the risk can be lessened by applying the fertilizer late, and the effect on the grain is not likely to be reduced thereby.

No Advantage in Splitting the Dressing A few experiments have been made to ascertain whether there is any advantage in dividing the dressing, giving half early and half late. There was no clear indication of any effect worth the trouble of performing two operations. Other experiments have been made to compare a single dressing of sulphate of ammonia with a double dressing applied in two instalments, one early and one late. Here the results have been variable. At Rothamsted there was no evidence that splitting the dressing served any useful purpose. In the Jealotts Hill experiments the splitting was advantageous in two seasons but not in the third. The differences involved are so small as to make it improbable that a final decision can come from field experiments alone, and greater knowledge of the physiological processes involved will be necessary. But in the meantime there is no good reason for advising farmers to go to the trouble of splitting the nitrogenous dressing. The two facts emerging clearly from the experimental work are that it is better to apply the sulphate of ammonia in spring than in autumn, especially if the spring and summer should be wet; and that a late application in spring yields as much additional grain as an early application, but it gives less straw and so involves less risk of lodging.

Sulphate of Ammonia in the Coming Season Finally, it should be emphasized that cereal crops are likely to need nitrogenous fertilizer during the coming season. For some years now there has been on many farms a good deal of cross-cropping, breaking away from rules of good husbandry. There has also been less farmyard manure, and its quality has been inferior, owing to the shortage of imported feedingstuffs. In these circumstances a dressing of sulphate of ammonia is likely to be effective, and it would be reasonable to expect a return of some 3 to 5 bushels of wheat for one cwt. sulphate of ammonia.

I—WINTER OATS AND WINTER BARLEY
II—GENERAL NOTE ON CEREAL GROWING

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AN announcement by the National Institute of Agricultural Botany on varieties of winter wheat recommended for cultivation in this country is made on pages 258–261 of this JOURNAL. A list is there given of the leading varieties that are likely to meet all the requirements of farmers, millers and poultry-keepers. Since these varieties are described in detail, it is unnecessary to mention them here, except as regards cultivation of the crop.

Winter Oats The choice of varieties in winter oats is much narrower than in wheat. The first essential of a winter oat is that it should be winter hardy. The old variety GREY WINTER is reliably winter hardy, but its straw is so apt to lodge that in practice its use is restricted to the less fertile soils and to dry districts. It is, nevertheless, particularly useful where winter hardiness is a first consideration. The grain has an exceptionally low husk content, and both grain and straw are of excellent feeding quality. The variety UNIQUE possesses similar qualities but its grain husk is white.

The variety BLACK WINTER is rather less winter hardy than the Grey Winter, and its grain—which has a black husk—has a slightly lower feeding value. Since it has weak straw there appear to be no sound reasons for growing Black Winter oats in preference to Grey Winter.

BOUNTIFUL is not fully winter hardy, but its straw stands better than either Black or Grey Winters, and it ripens earlier. It is well suited to moderately fertile soils of open texture in milder districts. Its large black-husked grain has a moderate feeding value. Bountiful can also be used for spring sowing.

The new variety PICTON represents a distinct advance upon the winter oats mentioned above. It possesses a similar degree of winter hardiness to Grey Winter, combined with a stronger and much better standing straw. Consequently it is adapted to soils in a higher state of fertility, where the previously mentioned sorts would lodge.

Picton ripens at about the same date as Grey Winter. It produces a large well-filled grain with a white husk, and its husk content is nearly as low as that of Grey Winter. Picton can be recommended for that wide range of soils which are too fertile for Grey Winter, but on the richest soils a stiffer-strawed variety should be grown.

The Aberystwyth oat S.147 also produces a large, plump grain with a thin white husk. Its straw is of medium length and stands well. Its winter hardiness is rather lower than that of Grey Winter and it is susceptible to attack by the stem eelworm. It can be recommended for autumn sowing on highly fertile soils, provided they are not infested with eelworm or

specially exposed to rigorous winter conditions. It is also suitable for early spring sowing. Under favourable conditions its kernel yield is likely to be as high as that of any other winter oat.

RESISTANCE oat was bred for autumn sowing, but unfortunately its winter hardiness did not come up to original expectations. Its short fine straw stands exceptionally well and is of high feeding quality. This variety is now recommended mainly for sowing in early spring—not later than February—on the richest types of oat soils. In milder districts it may also be sown in autumn on similar soils. It has rather small white grain with a fairly high husk content.

Attempts are being made to produce a more decidedly winter hardy oat of the Resistance type, having its excellent straw characteristics combined with better quality grain. The results in this direction, from crosses between Resistance and Grey Winter, are very promising and likely to give fruitful results in the near future.

The Aberystwyth S.172 oat is a winter variety remarkable for its short rigid straw. It is well adapted to the richest soils and for fertile land in districts of high rainfall. Under such conditions its straw may reach a height of 4 ft. but will stand to perfection. This variety is quite out of place on land of moderate fertility, particularly in drier districts, where its straw development is poor and its yield relatively low. It has rather small white-husked grain with a high husk content.

Where land is infested with stem eelworm (*Tylenchus dipsaci*) the damage to winter-sown oats may be very serious. Grey Winter and Picton are both highly resistant to this parasite, but unfortunately both S.147 and S.172 are rather susceptible. Where land is known to be infested, it is safer not to sow these two varieties. It is worth remembering, however, that the damage done by eelworm to spring-sown oats is usually very much less than to autumn-sown crops. The variety S.147 gives excellent results with early spring sowings, and is then less likely to suffer severely from eelworm attack.

Winter Barley Few varieties of barley are really winter hardy. Among these is the old six-row variety BERE, which, however, is only suitable for soils of medium fertility owing to the weakness of its straw; moreover, it is a feeding barley with no pretensions to quality. Early ripening crops, with grain of high malting quality, may be obtained from either Plumage-Archer or Spratt-Archer when autumn sown; but neither of these spring varieties is capable of withstanding severe winters, and may prove unreliable in exposed districts.

A new two-row barley with narrow ears, named PIONEER, has recently been introduced by the N.I.A.B. It was derived from a cross between Tschermak's winter barley and Spratt-Archer. In general appearance and malting quality Pioneer resembles Spratt-Archer, but it has a high degree of winter hardiness. Its straw is rather short and it ripens early. Though not yet grown on a large scale, it appears to be best adapted for soils of average fertility. It is recommended to growers who require an early ripening winter barley capable of producing grain of good malting quality.

II—A GENERAL NOTE ON CEREAL GROWING

Every farmer is aware of the existence of varying levels of fertility in his fields, or even in different parts of the same field. Such different fertility levels are primarily due to variations in the composition, depth and moisture-holding capacity of the soils. This natural fertility of the land is, however, modified by the treatment it receives in cultivation, manuring and cropping. A further potent factor in modifying a soil's natural fertility is the amount of rainfall associated with the district. The combined effects of climatic conditions, soil factors, and soil treatment lead to a given level of productive capacity which may be roughly described as high, moderate or low.

The ecological status of the chief cereals is generally appreciated, and we constantly speak in terms of land suitable for rye, barley, oats and wheat respectively. Cereal growers should carry this idea a stage further and realize clearly that the more distinct *varieties* of cereals are also adapted to different levels of soil fertility. Each variety needs to be grown at a suitable fertility level if the best results are to be secured.

For example, if the productive capacity of a soil is known to be of the order of 35–40 bushels of wheat per acre, no advantage is gained by using a variety capable of standing well, with a potential yield of 60–80 bushels. At the 35–40 bushel level of production, a wheat of the Squarehead's Master or Little Joss type is likely to give relatively better results than the potentially more productive varieties. Moreover, carefully conducted trials have shown that while most of the modern short-strawed wheat varieties can give substantially higher yields than the older sorts, they do so only at the higher levels of soil fertility; and the same is true of the other cereals. It seems to be generally true that, under conditions where lodging is unlikely, the main advantage of a short-strawed variety is lost. Short-strawed varieties like Holdfast and Jubilégem wheats, or Resistance and S.172 oats, should be definitely reserved for those levels of production where the longer-strawed sorts would lodge.

None of us likes to see lodged crops, and it is to the farmer's advantage and the national interest to produce yields up to the full standing capacity of the straw. The matching of a variety to the level of soil fertility to which it is adapted is a matter for each individual farmer. It is not the fault of the variety, nor of its breeder, if it is wrongly used. This question of adaptation of cereal varieties to the level of soil fertility to which each is suited is here laboured at some length because there is abundant evidence that the matter does not receive the attention it deserves.

Seed Rates and Row Spacing Nor should it be overlooked that various points in the cultivation and general crop management can add materially to the yield and standing capacity of a cereal. Such matters as the seed rate, spacing of drill rows, time of sowing, and so forth, affect the crop considerably. On the richest soils there is some danger of lodging, even when the stiffer-strawed varieties are used—especially in stormy seasons. In such circumstances a reduction in the seed rate and an increase of the space between the rows tend to raise the standing power of the crop. A seed rate of 7 to 8 pecks of wheat in place of 10 pecks, or of 3 bushels of oats instead of 4 bushels, will help in the desired direction,

as also will a row spacing of 10 inches in place of 7 inches. Under the less crowded conditions there is greater access of light and air to the lower parts of the stems, resulting in a firmer straw that is less liable to lodge.

On the richest soils excessive tillering and leaf production favours mildew attack, particularly during a mild winter, and the danger of lodging is increased. The application of a suitable spray at the right time—which must be before the ears appear—will reduce the excess of "flag" and assist the crop to stand better. Again, in similar circumstances the later sowing of autumn cereals, say in November rather than earlier, will give the crops a better chance to stand. On the other hand, experience clearly shows that on the poorer soils and those of medium fertility the early sowing of cereals—not later than October—is most favourable to plant establishment, tillering and grain production.

Restriction of space allows only brief reference to a few further important points in the cultivation of cereals.

Although the position of a cereal crop in the rotation need not be so rigidly fixed as in former times, certain precautions are necessary if loss from diseases and insect pests is to be avoided. There is much to commend the practice of separating cereal crops by one or two seasons in each rotation. This is the best means of preventing the spread of such diseases as Take-all and Eye-spot, which are responsible for so many ragged and unsatisfactory wheat crops.

The best place for wheat in a rotation is undoubtedly after a leguminous crop like clover, beans, peas or vetches. Bare fallow is a less certain preparation, owing to the danger from wheat bulb fly ; also wireworm may be troublesome after ploughed-up grass.

Drilling It is to be feared that too little attention is given to the details of drilling. One frequently sees crops in which the yields have been reduced directly as the result of bad drill work. In many cases the coulters are not properly set, so that the rows are spaced at irregular intervals and at uneven depths. The result is an uneven crop growth right up to harvest, with crowded plants alternating with thin patches. The advantages of good drilling over broadcasting are that the seed is deposited at a regular depth and evenly over the whole area ; with bad drilling these advantages are partly lost. Before using a drill it should be examined and tested to see that each coulter works at a proper and uniform spacing and depth.

Depth of Sowing In the writer's experience cereal grains are often sown too deeply. It seems to be the opinion of some growers that deeper sowing leads to a greater root depth. This, however, is a fallacy. Whatever may be the depth of sowing between the limits of, let us say, 1 inch and 4 inches, the main root system of all cereals originates at a point only just below the surface of the soil. For wheat and rye the most suitable depth appears to lie between 1 and 1½ inches, and for barley and oats between 1½ and 2 inches—the greater depths being more suitable on soils of open texture. Occasionally, deeper sowing may be advantageous by securing more moisture for germination, or in preventing loss of seed by birds, though probably in no other way.

GENERAL NOTE ON CEREAL GROWING

Fortunately there is a wide margin of safety in this matter of sowing depth, since the seedling plant adapts its development according to the depth at which the seed is deposited. When, however, cereal seed is planted at a depth greater than about 2 inches, there is a consequent loss of food reserves and of vigour to the young plant, and a slower rate of tillering. It is essential, however, that the seed should be well covered; and to ensure this a good level seedbed is most important.

A leaflet, *Notes on Growing Cereal Seed Crops*, can be obtained free and post free from the National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

WINTER WHEAT

LIST OF RECOMMENDED VARIETIES

Announcement by the National Institute of Agricultural Botany, Cambridge

THERE are at present about one hundred named varieties—or so-called varieties—of wheat in existence in the United Kingdom. This is clearly a disadvantage to those who purchase and distribute the home crop. They cannot readily bulk their purchases for large buyers who are apt, in consequence, to give preference to foreign supplies which arrive in large lots of uniform condition and type.

In considering the possibility of reducing the number of varieties, it is necessary to bear in mind (a) that wheat is required for several purposes, and (b) that it is grown under many differing conditions.

(a) It is required for *bread-making*, for which purpose a large proportion of "strong" steely grain is preferred; for *biscuit-making*, which demands "weaker" grain; and in peace time for *stock-feed*, principally poultry—for this the most important consideration is a stiff straw able to carry a high yield of grain.

(b) It is grown on soils of different *types* and varying levels of *fertility*, and in districts of varying *rainfall*; on some farms it is cut by the *combine harvester*, and on others by the *binder*. Finally, it is sown both in the *autumn* and the *spring*.

Thus the problem of wheat production and utilization is more complicated than that of malting barley, where in a few years it has been possible to divert some 80 per cent. of the crop on to two varieties—Spratt-Archer and Plumage-Archer—to the great benefit of all concerned.

Nevertheless, a beginning should be made to concentrate on those varieties of wheat which have hitherto proved themselves, each in their sphere, to be the best for the various purposes and conditions mentioned. To this end the following list of wheats for autumn sowing is issued after full consultation with millers, bakers, seedsmen and growers. It is hoped to publish a similar list for spring wheats in due course.

It must be pointed out, however, that there are other promising varieties which have not yet been fully tested for milling and baking qualities, or for

yield over a full range of soils and levels of soil fertility. Moreover, plant breeders may produce improvements at any time. For these reasons the list is subject to later amendment in the light of additional knowledge and experience; from time to time varieties may be removed from the list and others added.

It is recommended, however, that where growers have no definite evidence in favour of some other variety as suiting their own particular locality and conditions, they should give preference to the varieties on the recommended list which is as follows:

Holdfast
Redman
Warden
Yeoman

Wilhelmina: Wilma*
Juliana
Victor
Little Joss
Steadfast
Squarehead's Master or Standard Red

Jubilégem: Bersée*
Squarehead II
Vilmorin 27
Rivet

* Included provisionally.

The Institute does not propose to issue certified seed of varieties which are not in the recommended list.

The first four varieties—Holdfast, Redman, Warden and Yeoman—are primarily suited for bread-making; the next seven—Wilhelmina, Wilma, Juliana, Victor, Little Joss, Steadfast, and Squarehead's Master—for biscuit-making. The remainder are good yielding wheats which are used only for milling, and baking to a limited extent, varying with commercial requirements.

The choice of the recommended varieties in relation to the physical character of the soil, to its level of fertility, and to the rainfall is most important. This is indicated in the Table on p. 261. It will be observed that there is overlapping. Little Joss, for instance, is recommended for light soils of low and average fertility, and also for medium soils of low fertility. In the same way Juliana, Victor, Wilhelmina and Wilma are recommended for light, medium and heavy soils, but on light soils their use should be confined to those of high fertility in districts of high rainfall: on heavy soils, which retain moisture, their use should be restricted to conditions of average fertility, since their standing power is not equal to that of varieties such as Yeoman, Holdfast, etc. Rivet presents another illustration of the importance of choosing a variety suited to the conditions in which it is grown. Possessing a very long and whippy straw, it is recommended for heavy soils only when they are of low or average fertility On soils of similar texture but at a high level of fertility its straw is likely to become unmanageable.

WINTER WHEAT—RECOMMENDED VARIEITES

The following is a brief description of the wheats in the recommended list:

High Quality Milling and Bread-making Varieties

Holdfast White grain and chaff. Ripens slightly earlier than Yeoman, with shorter straw and better resistance to lodging. Should be used only on soils of medium and heavy physical texture in a state of high fertility; under these conditions it has a wide range of adaptability.

Redman A red-chaffed variety of the Yeoman type, and produces grain of almost equal quality.

Warden Ears of medium density with white chaff and grain. The straw is of medium length and does not stand so well as Holdfast, and the variety, while suited to high fertility conditions, should not be used on the very richest soils. The quality of the grain is almost equal to that of Yeoman.

Yeoman Smooth white chaff and red grain of high milling and baking quality. Ripens about the same time as Squarehead's Master. The straw is relatively short and clean, and comparatively free from attacks of Yellow Rust. Yeoman is at its best on highly fertile soils or when intensively manured.

Varieties Particularly Suited to Biscuit-making

Wilhelmina A variety with a dense, somewhat square ear of medium size; the chaff is smooth and white; white grain. The straw is of medium length and stout. Suited to heavy and medium soils in good average condition, and to fertile light soils in districts where the annual rainfall is not less than 25 in. Under such conditions it is a reliable high-yielding wheat.

Wilma A recent selection derived from Wilhelmina; it closely resembles that variety in appearance and general qualities.

Juliana Very similar in description and in yield of grain to Wilhelmina. The straw is slightly shorter and more resistant to lodging. Its soil requirements are identical with those of Wilhelmina.

Victor Very similar to Wilhelmina in all respects.

Little Joss Long, lax ears with smooth red chaff and red grain. Ripens about the same time as Squarehead's Master. Straw long, leafy and rather weak. Highly resistant to Yellow Rust. Essentially a variety for light soils, but can be grown on soils of medium physical texture provided the level of fertility is low—that is, where there is no inducement to an over-development of straw.

Steadfast A recent introduction, having rather denser ears than Little Joss, with smooth red chaff and white grain. Straw shorter and stronger than Little Joss but with the same high degree of resistance to Yellow Rust. Steadfast can be used on rather more fertile soils than those required by Little Joss.

Squarehead's Master This is still one of the predominant wheats in use. 13/4 has proved to be the highest-yielding selection of this variety. Square-shaped ear of medium density with smooth red chaff and red grain; ripens fairly early. Straw of medium length and strength which seldom lodges badly. A reliable and consistent yielder on a wide range of soils of medium texture and fertility.

Other Varieties

Jubilégem A Belgian variety with an ear of medium density, with white, smooth chaff and red grain. The straw is short and stiff and the ear when ripe is generally held erect. It is a heavy-yielding variety which ripens early and is suitable for the richest classes of soil in all districts.

Bersée A French variety similar in type to Jubilégem but with somewhat longer straw and maturing slightly earlier. Its yield of grain is similar to that of Jubilégem.

Squarehead II A wheat of the Squarehead's Master type but possessing shorter and better-standing straw.

Vilmorin 27 A French variety with an ear of medium density, having white, smooth chaff and red grain. The straw is short and resistant to lodging. It is an early ripening wheat giving high yields on rich soils, but is very susceptible to Loose Smut.

Rivet A bearded wheat with a large ear and red grain. The straw is long, resilient and stands moderately well. It is late in ripening, but gives heavy yields of both grain and straw. Rivet is essentially a variety for soils of low fertility, provided there is an adequate supply of soil moisture. Of various selections, Rampton Rivet is the highest yielding strain of this type of wheat; it has also the best standing straw.

Recommended Varieties of Winter Wheat

The types of soil and levels of fertility to which the recommended varieties are particularly suited:

Physical Character of Soil	Level of Fertility	Variety
LIGHT	Low, Average	Little Joss
	High	Juliana, Victor, Wilhelmina, Wilma *in districts of high rainfall*
MEDIUM	Low	Little Joss, Squarehead's Master or Standard Red
	Average	Squarehead's Master, Squarehead II, Steadfast, Juliana, Victor, Wilhelmina, Wilma, Bersée
	High	Holdfast, Redman, Warden, Yeoman, Jubilégem
HEAVY	Low	Rivet
	Average	Rivet, Bersée, Juliana, Victor, Wilhelmina, Wilma
	High	Holdfast, Jubilégem, Redman, Vilmorin 27, Warden, Yeoman

The above is obtainable in leaflet form (Farmers' Leaflet No. 8) free and post free from the National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

CERTIFICATION OF CEREALS

H. Hunter, M.A., D.Sc.

Acting Director, National Institute of Agricultural Botany, Cambridge

ON pages 260-1 of this issue of the JOURNAL is a list of sixteen varieties of winter wheat at present recommended for use in this country, and to this is added a note that the National Institute of Agricultural Botany will not issue *certified seed* of varieties that do not appear on this list. What does this mean?

The term "certified seed" means that the Institute certifies:

(a) that the original seed from which the stock has been grown is of known origin;

(b) that it is true to name;

(c) that it has been multiplied under conditions of strict control every year and at every stage from the field to the sealed sack;

(d) that the seed in the sack is in fact the seed over which this care has been taken from the year the stock began as the produce of a single plant and not some other seed advertently or inadvertently substituted for it.

Certification does not apply to any standard of germination or freedom from weed seeds. This is a matter of testing the individual sample, whereas certification deals with breeding and family history: it represents the pedigree "herdbook" of the seed world.

Confined to Recommended List

Clearly it is not worth taking all this trouble with any but the best varieties, hence the decision to confine operations to the recommended list of wheats—the varieties so far found to be the most suitable for the main purposes and under the main conditions met with in this country. But there is a further refinement. Most stocks of cereals of the varieties in common use are in reality mixtures of well-defined strains within the variety, and it has been found possible to select individual strains superior to the aggregate from which they came. These selections may be superior in yield, in standing power of the straw, in resistance to disease, in earliness of ripening, or in other ways, these advantages contributing either individually or collectively to greater agricultural and commercial value. Thus Rampton Rivet is a selection of Rivet which has been proved superior in yield and standing power to other Rivets; Squarehead's Master 13/4 is similarly a more prolific and better standing selection than other selections of this wheat against which it has been tested, and a type of Spratt-Archer which is 7–10 days earlier in ripening than other forms of this barley has also been isolated. Another example of selection, better known because it has received a name differing from the stock from which it was derived, is Wilma—a selection obtained from the well-known variety Wilhelmina. One is still in course of being tested against the other. These are but a few examples; there are many others amongst varieties.

Field Inspection Alone Insufficient

This leads to a consideration of the value of inspections in the field. Before the war the general standard of seed obtainable from responsible sources was high as regards both its trueness to name and freedom from contamination. But the rapid and widely extended increase in the acreage of all cereals during the past four years made unprecedented demands upon supplies of seed, and called into use stocks that under

normal conditions would not have been employed for this purpose. The effect of this can be seen in the mixed character of very many crops, more particularly of wheat in districts which previously were not predominantly wheat-growing areas.

Some War Agricultural Executive Committees have recently tried to correct this by inspecting growing cereal crops and earmarking for seed those which appeared to be true to variety and were free from the commoner fungus diseases. This is all to the good at a time like the present : it cuts out the use for seed of obviously unsuitable crops. But it is of very great importance that it should in no way be confused with certification. We cannot, as it were, enter seeds in the "herdbook" by inspection alone. Selected strains, as explained above, are indistinguishable by sight from one another, and so even are some varieties. For certification we must know not only the origin of the seed and that the crop we see is the authentic descendant, carefully controlled year by year to avoid both contamination and substitution—for mistakes are easily made. We must know that the seed which eventually comes on the market is in actual fact derived from the crop we are inspecting, and that it will not be threshed in a drum that has not been cleaned or contaminated with some other variety in the cleaning machine or on the barn floor.

It is all these uncertainties that certification sets out to guard against, and guard against with the utmost strictness and care. Only so will a certificate and a sealed bag of "certified seed" really mean something. With adequate supervision to avoid mechanical admixture, there is no reason to anticipate deterioration in the value of the stocks beyond what may proceed from genetical changes over which breeders have no control at present. Close observation of cereals during recent years has shown that many varieties, especially some of hybrid origin, do produce aberrant forms, often of a definite description, from time to time. Variations of this nature may arise at any stage and can be kept within limits only by sustained vigilance, and "roguing" whenever necessary.

Certification Procedure When a new variety or selection arrives from a plant breeding station or seedsman, the first step taken by the Institute is to test it by comparative trials over at least three years in as many different districts and soils as possible. If these trials prove satisfactory the next step is the multiplication of stocks from a few bushels to a hundred or more quarters. This entails supervision every year of drilling, inspection and roguing of the growing crop, supervision during threshing, final cleaning and the sealing of the bags. As can be imagined this is no light task, particularly as much of the work is apt to be concentrated into certain short periods.

When a sufficient quantity for placing on the market has been produced, the sealed bags of "certified seed" go forth to those who undertake to increase still further the quantity by growing it for seed for at any rate one more year under similar conditions of control, either by themselves or in co-operation with local agricultural authorities or growers' associations.

If one hundred quarters of a variety are distributed by the Institute for growing for seed, it will plant 300 acres the first year, 5,000 the second and 80,000 the third year after certification, i.e., if it were all saved for seed—which of course, after the first year, it is not. These figures illustrate, however, both the rapid influence on the national crop that adequate supplies of improved seed can exercise and the importance of maintaining inviolate the principles of certification, thus ensuring true propagation of superior varieties and strains of known origin grown throughout their whole life under conditions of strict supervision so as to retain without question the authenticity and identity of the stock and its freedom from contamination.

BUNT OF WHEAT

W. A. R. Dillon Weston, M.A., Ph.D.

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BUNT or Stinking Smut of wheat is a disease which has been known to farmers for many centuries, but although so well known and so easily prevented, it still causes much loss in this and other wheat-growing countries. Bunt is caused by the microscopic fungus *Tilletia caries*, and like other fungi it propagates by spores. It is these which contaminate the grain and ultimately lead to infection. The disease, therefore, is one which is seed-borne.

The life history of the fungus and the course which the disease takes (assuming that no preventive treatment is given) are as follows. The wheat is sown and starts to germinate, but at the same time so do the bunt spores which may be present on its surface. These produce minute fungal threads which pierce the young shoot and work their way to the tip of the stem, where they keep pace with its growth. Later these threads, or *hyphae* as they are called, gain entrance to the tissue which normally gives rise to the grain. Here they divide into myriads of spores. Thus instead of a normal wheat grain developing, a "bunt ball" is formed. These deformed grains contain a black mass of spores, at first greasy but later becoming powdery, and having a strong fishy smell. It is this unpleasant symptom which gives the disease its alternative name.

Seed Disinfection Prevents Bunt Sprinkling with, or steeping seed wheat in, a solution of copper sulphate (bluestone) will prevent Bunt, as will also a solution of formalin similarly applied. Both these wet treatments, however, have certain disadvantages, and they have now been superseded by dry dusting with organo-mercury seed dressings. These, besides preventing Bunt of wheat, will control Covered Smut and Leaf Stripe of barley, and Smut and Leaf Spot of oats. They do not, however, prevent the occurrence of Loose Smuts of wheat and barley.

Seed already dressed with these dusts can be obtained from a large number of seed merchants, but with home-saved seed the work must be done on the farm. The most effective way is to mix the seed and the dressing by rotation in a machine of the barrel or churn type. Inexpensive machines of this kind can be purchased, or a home-made one can easily be constructed. Another type is the gravity dresser ; with this the mixing is done not by rotation in a barrel but by the falling of grain and dust over a series of cones contained in a hollow cylinder. But the mixing is not so thorough as that obtained by "churning" the seed and powder together in a drum.

Germination Unaffected Provided the grain shows high initial germination, is of sound physical condition, and is superficially dry when dusted, no injury is likely to result from seed dressing. Further, if such seed has to be stored, even for several months, it is unlikely that any significant loss of germination capacity will occur provided the seed is kept under dry, cool conditions, with adequate ventilation. *If the grain is not well conditioned and is slightly damp, it should not be dressed in advance and stored, but should be treated immediately before sowing.*

It should be noted that organo-mercury seed dressings contain a *poison*, and they should therefore be used as directed by the manufacturer, and ppropriate precautions taken.

See illustration on p. 265.

CALF-REARING (See p.p. 271-274)

MAMMERTON, DERBY (March, 1944) (Photos. *Farmer and Stockbreeder*

Top: Four bull calves out of recorded cows.

Bottom: A group of five-months-old, weaned calves.

(Photos: *Farmer and Stockbreeder*

Top. Six- to eight-months-old calves at Mammerton (March, 1944).

Bottom. Bought calves six- to eight-months-old at Bretby Park, Derby. (July, 1944). All were reared on milk substitute from a fortnight old.

THE VALUE OF PROVEN SIRES (See pp. 275-276)

HASTOE MILLICENT II. A daughter of "Double Imperial"—Royal Show Champion, 1935, and awarded first prize Royal Show, 1936. Milk yield averaged 9,530 lb (3.55% B.F.) with her first five calves.

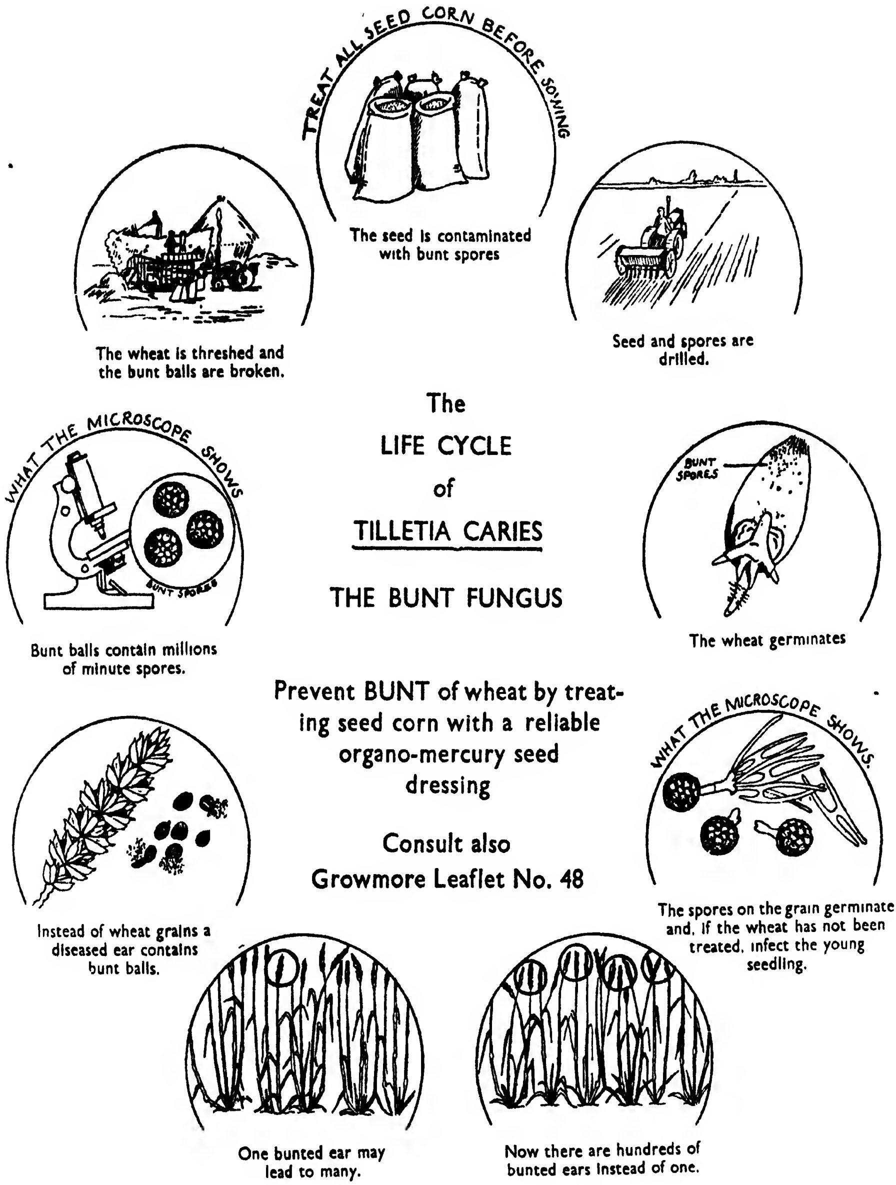
(Photos: *G. S. McCann*)

This group of seven cows by Wicklesham Darlington Prince 4th averaged 7,034 lb milk (3.62% B.F.) with their first calves, the highest yield being 10,101 lb. milk in 320 days. The seven cows averaged a maximum daily yield in their present lactation of 57½ lb.

(Photos. *Sport and General*

British Friesian cow, "Terling Torch 36th." She had an excellent showyard career and produced sixteen full-time calves. With her first twelve calves she averaged 11,815 lb. (3·60% B.F.) and during her lifetime gave a total yield of over 64 tons.

Top: In her prime.


TREAT ALL SEED CORN BEFORE SOWING
The seed is contaminated with bunt spores
Seed and spores are drilled.
BUNT SPORES
The wheat germinates
WHAT THE MICROSCOPE SHOWS.
The spores on the grain germinate and, if the wheat has not been treated, infect the young seedling.
Now there are hundreds of bunted ears instead of one.
One bunted ear may lead to many.
Instead of wheat grains a diseased ear contains bunt balls.
WHAT THE MICROSCOPE SHOWS
BUNT SPORES
Bunt balls contain millions of minute spores.
The wheat is threshed and the bunt balls are broken.
The
LIFE CYCLE
of
TILLETIA CARIES
THE BUNT FUNGUS
Prevent BUNT of wheat by treating seed corn with a reliable organo-mercury seed dressing
Consult also
Growmore Leaflet No. 48

CHOCOLATE SPOT OF BEANS

W. C. Moore, M.A.

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TO the farmer Chocolate Spot is an annoyance and at times a source of disappointment and heavy loss. To the plant pathologist, who cannot yet provide the remedy that is expected of him, it is, and always has been, a very awkward disease to deal with. There are a few diseases which can easily be avoided or soon overcome, and there are many which can be kept within bounds by those willing to carry out the necessary measures of control. But the behaviour of Chocolate Spot is erratic and unpredictable ; and unfortunately little can be done about it. Its origin was a mystery when it was first reported causing serious damage to winter beans near Northampton nearly a century ago and, though theories and conjectures were not lacking, it remained a mystery until some ten years ago when Dr. A. R. Wilson studied the disease at Cambridge and proved conclusively that it was caused by the grey mould fungus, *Botrytis cinerea*. Thus the disease which defied identification for so long proved in the end to be due to the commonest of fungi ; for grey mould lives everywhere on all sorts of dead and decaying vegetable matter. Moreover, given the humid conditions under which it thrives, it will pass from dead to living tissues, killing them and often spreading at an alarming rate through crops of many different kinds. Indeed, the difficulty of giving sound practical advice about the control of the fungus is largely bound up with its omnivorous habits and its capacity for very rapid spread.

Symptoms Chocolate Spot may be found in winter beans from December onwards in the form of rich sienna brown spots on the leaves and stems. The spots vary in number from few to many, and in size from minute dots to conspicuous round blotches about one-third of an inch in diameter. Some years the disease remains more or less in this condition until the crop is mature, and though brown markings develop later in the season on the pods and sometimes on the seed coats, the disease has little or no effect on yield and therefore passes without comment. More often, however, as the mean temperature rises, the fungus becomes aggressive at one time or another between April and July, the precise period usually coinciding with a spell of wet or humid weather. When this happens the chocolate spot appearance is soon lost. The spots become so numerous that they run together and cover the leaves, reddish-brown streaks several inches long appear on the stems, and within a matter of days the plants take on a blighted appearance. The leaves hang limp and withered, the blossoms may be killed and soon little may be left of the plants but blackened stems and half-formed pods. Spring-sown beans, on the other hand, either escape the disease altogether or show only the spot stage, which causes no damage.

Occurrence and Relation to Weather There can be no question that Chocolate Spot is far and away the most serious disease of field and broad beans. Even in a normal season it must be responsible for appreciable loss, and in years when epidemics occur, yields may be reduced by 50 per cent. and many crops are

rendered useless and have to be ploughed under. Too much emphasis on the bad years, however, is apt to give an exaggerated idea of the importance of the disease. Examination of the reports on the prevalence of Chocolate Spot, accumulated over the past 28 years, enables a true perspective to be obtained. During that period there have been serious epidemics over the greater part of the country on five occasions, or only about one year in six. In five other years local epidemics have developed, mostly in southern or western districts; in eleven years the disease has been more or less normal in incidence, while in seven years it caused only slight damage or was virtually absent.

A little further study reveals how closely this seasonal variation in attack is bound up with weather conditions, particularly with winter and late frosts, and spring and summer rainfall. Weather injury in winter and spring means plenty of dead or damaged foliage on which the *Botrytis* can begin its development. The lower leaves in particular are killed by frost and it is these older leaves that normally constitute the chief source of the *Botrytis*. Late spring frosts have an added influence and greatly aggravate the trouble. This year, for instance, the upper portions of many of the main shoots damaged by May frosts in East Anglia, Yorkshire and elsewhere, were later killed by Chocolate Spot, and soon became covered with *Botrytis* spores. The dead tops of these shoots therefore provided a ready source from which the fungus could attack the bunch of lateral shoots produced lower down the stem to replace the dead main shoot. If winter injury and frost damage give rise to the dead or weakened bean material on which a big reservoir of *Botrytis* is built up, it is rainfall that determines the severity of attack on the crop. Air temperatures of 60–68° F. best suit the *Botrytis*, and the fungus spreads rapidly only when the weather is wet or very humid.

The worst attacks may be expected when late frosts are followed by wet weather. The severe May frosts of 1935 and 1944, for example, were followed by wet weather in June or July, and led to the two worst epidemics of Chocolate Spot in recent years. Late frosts also occurred in 1938 but were not followed by a serious epidemic outbreak because the subsequent weather conditions were not particularly favourable to the fungus.

As far as yield is concerned the periods when rain falls are as important as the actual amount of rainfall. A warm wet spell at flowering time may mean the death of many blossoms, and a week of heavy rain or muggy weather in early July often leads to the complete loss of many crops. On the other hand, wet periods after blossoming, though conducive to blackening crops and gloomy forebodings, may well have less serious effects; for with a later change to drier weather, the crops partially recover and give a reasonable, or at any rate an unexpected, return.

The erratic nature of the disease is shown not only by wide variations in the severity of attack from district to district, but also from field to field on the same farm or in the same locality. Regional differences can usually be traced to variations in weather; and local differences may be a result of different manurial treatment or of the existence of "frost pockets" in low-lying fields. None the less, there are many instances of wide differences between one field and the next for which no satisfactory explanation has yet been forthcoming.

Sources of the Botrytis There is no reason to suppose that the *Botrytis* which attacks beans is in any way restricted to this crop. In fact, strains of *Botrytis cinerea* collected from other sources are known to be capable of producing Chocolate Spot on beans, and the

fungus from beans will attack other crops, such as sainfoin and vetches. Consequently, although it is the *Botrytis* spores produced on fallen bean leaflets, and on bean foliage killed or damaged by frost and wind, that doubtless provide the chief source of infection, there is always the chance that the fungus may be blown over to bean crops from almost any plant debris in the neighbourhood.

Another possibility deserves to be mentioned if only because it has not yet been investigated. As previously mentioned the fungus sometimes causes brown markings on the seed coat, and it may therefore be carried over with the seed. If such infected seed gives rise to weak or diseased shoots covered with *Botrytis*, they may well serve as potent sources for scattered early infections among an otherwise healthy bean crop.

Potash and Phosphate Deficiencies predispose Crop to Disease There is plenty of experimental evidence to show that deficiency of potash in the soil predisposes beans to attack by Chocolate Spot, even when the deficiency is not serious enough to produce visible symptoms in the crop. The disease also tends to be worse in soils containing low amounts of available phosphate. In some districts bean crops have begun to show the effects of short supplies of artificial fertilizers under war-time conditions. They are stunted on account of deficiency in potash or phosphate, or both, and the leaves show the marginal scorching typical of potash deficiency. Where this is combined with attacks of Chocolate Spot—and the dead leaf margins may form a good breeding ground for the *Botrytis*—the result is usually disastrous. Unfortunately adequate or even generous manuring with potash is not an infallible method of preventing the disease, but very often it does make all the difference between a mild attack and a severe epidemic. The same may also prove to be true for phosphate.

Other Predisposing Factors Spring-sown beans rarely suffer at all badly. Winter beans sown in September or early October are sometimes, but by no means always, more seriously affected than those sown later. The disease is usually worse in low-lying patches, especially on the heavier soils, in badly drained or waterlogged soil and, in general, under conditions that favour moisture among the plants. The practice of sowing broadcast and ploughing the seed in, for example, makes for thick crops that hold moisture. Previous cropping has little or no influence on the disease.

Prospects of Control There is no practical remedy for Chocolate Spot. A few small-scale spraying trials have been carried out from time to time, but there is as yet no evidence that an epidemic attack can be prevented by spraying or dusting. *Routine* spraying or dusting of field beans for Chocolate Spot, however, is unlikely ever to prove a practical or profitable undertaking unless it can be combined with the control of bean aphis. An alternative would be to seek a suitable spray for application on the relatively few occasions when weather conditions during spring and early summer clearly favour epidemic outbreaks, but it is very doubtful if any spray would effectively control the disease once an epidemic had begun or was imminent. On the other hand, sprays or dusts for use on specially valuable stocks and on broad beans under garden conditions would be helpful.

Under present conditions the extent to which adequate manuring is possible must depend on the supply of fertilizers. When happier days return, however, it will be well to remember that a dressing of 1½ cwt. per

acre of muriate of potash or an equivalent amount of potash in another form, such as 6 cwt. of kainit per acre, may and probably will save a crop from the worst effects of Chocolate Spot. As heavier dressings may be necessary for a time on many soils after the war, farmers who grow beans are advised to have their soils analysed so that the potash and phosphate requirements can be ascertained precisely.

Meanwhile, it is not necessary to take too gloomy a view if the crops begin to show a blighted appearance in May or June. The disease that spreads so rapidly during wet weather is checked just as quickly by dry weather, and those who resisted the temptation to plough or cut during the epidemic that developed in the south-east of England early in June, 1941, were later rewarded, for the return of hot, sunny weather stopped the spread of the disease and, on the whole, final yields were one-half to two-thirds of the original estimates.

PRINCIPLES OF RATIONING FOR DAIRY COWS

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THE correct feeding of dairy cattle is by no means a simple matter. The ration must be adequate for maintenance, production and reproduction. In general, the maintenance ration—that is, the requirements for maintaining body temperature and live weight, etc., without production—is met by supplies of farm crops such as hay, silage, roots, etc., and the production ration is met partly by supplies of farm "concentrates" such as oats and other cereals and partly by straight feedingstuffs and compounds purchased from the provender miller.

Strictly speaking, the total requirements should be balanced for each animal, and this is in fact the common practice on up-to-date farms. There is no point, for instance, in feeding the same ration to a high-yielding cow as to a dry cow; and similarly a cow of 9 cwt. live weight would require different rations from one of 12 cwt. By a system of recording milk yields and live weight, it becomes possible to feed each animal at the most economical level so that it receives sufficient nutriment without waste.

Seasonal Adjustment of the Ration

A seasonal variation in the ration is also required; the principles of feeding in winter and in summer are quite different, in that during early summer the cattle are on young grass of high digestibility and high protein content, and the concentrate ration should be modified in proportion. Towards the end of the summer the grass becomes mature and fibrous, and the protein content is considerably lower, so that the ration should be adjusted accordingly. Later in the year, when the cattle are mainly indoors and fed on a maintenance ration of roots and hay, a further adjustment is essential. Also, the concentrate ration in spring should be of a rather binding nature to counteract the laxative tendency of young grass; whereas in autumn it may be required to have either laxative or binding properties in varying degree, depending upon the nature of the maintenance ration.

The merchant's aim is to supply either straight feedingstuffs or compounds to balance the home-grown materials on the farm. At the beginning of the year, when animals are put out to grass, they will be obtaining more than their maintenance requirements from this source ; in fact, the average cow can obtain almost all her production requirements from young grass of really good quality. The concentrate requirements will increase steadily throughout the year until in autumn practically the whole of the production ration will be in the form of concentrates on the average farm. It is not sufficient for the compounder to produce only one dairy meal ; he should preferably have a fairly wide range of compounds for animals receiving different maintenance rations. Not only should the ingredients of these be different, but also the protein and starch equivalents should vary over a certain range, according to the extent to which the protein or starch equivalents of the maintenance ration are balanced for the actual maintenance requirements.

Balancing Protein and Starch

It is generally assumed that the maintenance ration of the average cow should contain 6 lb. of starch equivalent and 0.6 lb. of protein equivalent per day for an average live weight of about 1,000 lb. The figures naturally vary according to the actual live weight. For production of each gallon of average milk, about 2.5 lb. of starch equivalent and 0.6 lb. of protein equivalent are required. For maintenance plus 3 gallons of average milk, therefore, total requirements are 13½ lb. starch equivalent and 2.4 lb. protein equivalent. If the actual value of the maintenance ration is subtracted from these quantities, the difference must be supplied by the production ration of compounds or straight feedingstuffs. It is fairly obvious that in the majority of cases the maintenance ration of roughage and roots will not supply exactly the required nutrients for maintenance ; it may, for instance, have an excess or deficiency of protein equivalent, so that the supplementary concentrates should be balanced accordingly.

Nevertheless, these figures emphasize the necessity for a carefully balanced ration, not only as regards starch equivalent and protein equivalent, but also as regards minerals and vitamin supplements. Supposing that the maintenance ration is balanced, it is obviously wasteful to supply a concentrate mixture containing much more than 0.6 lb. of protein equivalent when it is supplying 2.5 lb. of starch equivalent. This excess protein is not fully utilized and may in fact lead to rather harmful effects, in that an excess of protein may cause scouring. From the farmer's point of view it is more economical to buy a really good quality compound than an inferior one at a lower price. A compound with a starch equivalent of 70 and a protein equivalent of 17 need only be fed at the rate of 3½ lb. per gallon of milk to give the required nutrients. If, however, the starch equivalent is down to 63 or the protein equivalent to 15, then the compound would have to be fed at 4 lb. per gallon. Note that it is not necessary for *both* of these factors to be down ; a reduction in either of them would require a higher level of feeding.

Production Ration must not be too Bulky

Further, there is a limit to the amount of food that the animal can consume ; 33 lb. of dry matter per day is about the maximum. A large proportion of this will be accounted for by the maintenance ration, and it is essential, therefore, that the production ration should be highly concentrated to obviate unnecessary bulk, especially for deep milking cows. If the compound is of lower quality, more will have to be fed, and it is

probable that in many cases the amount required will exceed the cow's appetite, inevitably leading to a drop in production. In many large-scale feeding trials the substitution of a really good compound for an inferior one has markedly increased the milk production of a supposedly low-yielding cow.

Each dairy cow is capable of producing a certain amount of milk, but to attain this maximum the food must contain the correct amount of nutrients ; otherwise the food is the limiting factor. The wise stock-feeder always uses the best compounds or "straights" available, and feeds them at a level slightly higher than theoretical requirements. In this way he ensures that the stock are receiving adequate food and are maintaining maximum yields. The food supply can then be adjusted up or down, according to the production statistics.

CALF-REARING

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ACCORDING to suitability, liberality of feeding and freedom from illness, young calves may gain at the rate of 12 to 14 lb. per week and show the fat-calf bloom, or at the other extreme they may average less than 5 lb. per week and appear more or less emaciated. Those on the lower plane of nutrition often suffer from scour and are subject to pneumonia, peritonitis and navel-ill.

The high rate of weekly gain, which requires either a nurse-cow or a daily allowance of 2 gallons of whole milk, is typical of the production of veal or baby beef and the rearing of valuable pedigree cattle. In commercial rearing, however, it is not considered necessary or economic to produce during the first three or four months a rate of gain which is unlikely to be maintained on the pasture or winter fodder on which the calf has to subsist after weaning. Calves under two months old have all the appearances of normal healthy growth when making a steady liveweight increase of 7 lb. per week ; in fact, that rate of progress cannot be maintained when there is any nutritional trouble ; and that is the gain which may normally be expected during the first two months on a daily allowance of one gallon of whole milk supplemented with good hay and a ration of box food. Higher gains may be expected after the eighth week, by which time the calf's appetite for dry concentrates has begun to develop rapidly.

Owing to the cost of whole milk, especially in winter when the price is about 2s. 6d. per gallon, a daily allowance of one gallon incurs an expense which tends to exceed the value of the weaned calf. Various methods have been tried and numerous experiments have been carried out with the object of obtaining information on the problem of substituting whole milk in the calf's diet. Recent work on the part played by vitamins has thrown light on some of the difficulties previously attributed to indigestion or infection.

Whole-milk Method Uneconomic The simplest of the artificial methods of rearing is that of gradually reducing the allowance of whole milk as the calf eats more dry food, which it begins to take at about the third week. Given good hay, a suitable mixture of

concentrates and with water always accessible, the standard allowance of whole milk may be cut down in stages from about the seventh week to the tenth, by which time the calf is able to eat 3–4 lb. per day of balanced concentrates; these, however, must contain ½ oz. of tested cod-liver oil (to supply the requisite vitamins A and D) and a similar allowance of a cattle mineral mixture. No gruel need be fed.

The drawback to the above method is still the quantity of whole milk required, amounting to 70 or 80 gallons, which, at winter prices, is worth about £10. This sum added to the original value of the calf, plus the cost of labour, concentrates, etc., makes the weaned calf appear to have been reared at a loss. As things are, the cost of adequate milk feeding does limit the numbers of calves reared and is partly responsible for the unsatisfactory results obtained from ill-advised attempts to over-economize in rearing costs.

Use of Milk Substitutes In rearing on a milk substitute, the critical period is the first five or six weeks—while the calf is unable to eat sufficient dry food to compensate for any deficiencies in the liquid diet. The problem is not simply one of designing a mixture of easily digested foods giving a nutritive ratio similar to that of whole milk; and, important as are sterilized feeding pails, regular meals, weighed quantities, and measured temperatures of liquid food, these precautions will not prevent nutritional scours that are due to deficiency of vitamins A or B; neither will hygiene nor warmth prevent pneumonia and other infectious diseases to which the calf may have been predisposed by a blood-plasma deficiency in vitamin C, due to lack of colostrum or too early cessation of new milk feeding.

Scour due to deficiency of vitamin A may occur in young milk-fed calves in winter (even those which have had colostrum) if the cows are being fed on a deficient diet—that is, one lacking sufficient green hay, silage or kale. This problem need not occur in rearing on a milk substitute where cod-liver oil is used. Dunlop and the writer demonstrated in 1937[1] that a daily allowance of ½ oz. of tested cod-liver oil* satisfied the calf's requirements of vitamin A when rearing home-bred calves on fresh separated milk; and, incidentally, this allowance gave better results than the quantity that was formerly recommended—2 to 4 oz. per day—when cod-liver oil was added to separated milk with the object of replacing the fat removed by the separator.

The problem of deficiency in vitamin B was encountered in our 1938 experiments, when roller-dried skim milk was used in place of fresh skim milk in the diet of young calves which had not received three weeks' preparation on whole milk and had not yet learnt to eat hay and bran. There was a tendency to scour and cases of paralysis occurred, which, however, responded to treatment with yeast. In subsequent trials 5 per cent. of dried yeast was found to prevent paralysis, and when the quantity was raised to 10 per cent. of the dry food used to constitute the suckling fluid, the nutritive properties of the mixture were further improved.

Derbyshire Practice with Fortified Dried Skim Milk The rearing of calves on dried skim milk so fortified has been practised extensively in Derbyshire during the past six years, and visitors to the farms occupied by the War Agricultural Executive Committee, where comparatively large numbers of calves at different stages have been seen, have invariably been impressed with the results of this method.[2] The mixture used is composed of dried skim milk, 78 per cent.;

* Pre-war strength.

dried whey, 10 per cent.; dried yeast, 10 per cent.; and tested cod-liver oil, 2 per cent. This is made up at the rate of 1–1½ lb. per gallon of water and fed at a temperature of 98° F. in two feeds daily.

The calves are fed colostrum while available and only whole milk for the first fortnight, after which reconstituted skim milk is introduced and gradually increased, replacing whole milk, which is excluded after the fifth week. The best green hay and bran are fed as soon as the calf will eat (about the third week), but rolled oats of the best quality are the main concentrate until the calf's appetite for box food has developed sufficiently to permit of the introduction of linseed cake or calf-rearing nuts and a corresponding reduction in the quantity of milk powder. Cod-liver oil and a cattle mineral mixture are added to the box food after the displacement of milk powder has begun.

The feeding chart supplied for the guidance of the attendants is as follows (*quantities per day*):

Week	Whole Milk *gal.*	Milk Substitute *lb.*	Oats and Bran	Cake *lb.*
1st	¾			
2nd	1			
3rd	¾–½	½–¾	2 oz.	
4th	½–¼	1–1½	4 ,,	
5th	¼–⅛	1½	½ lb.	
6th		1½	½ ,,	½
7th–12th ..		1	1 ,,	1
13th–17th ..		½	1½ ,,	1½
18th–26th ..			2 ,,	2

This schedule reduces the requirement of whole milk to 20 gallons, thus saving 50–60 gallons of the quantity needed by the previous method and replacing it with 95 lb. of milk substitute powder costing £2 10s. The saving per calf amounts to about £5 on winter milk prices and £2 in summer.

Two Common Practices Some farmers discontinue pail feeding long before the seventeenth week, adding the daily ration of milk substitute powder to the other box food and depending upon the calf to drink the appropriate quantity of water. Calves that have made good progress can, at 9 or 10 weeks old, eat 3 lb. of equal parts milk substitute powder, rolled oats and nutted cake and dispense with pail feeding. There is considerable saving of labour in this method of feeding, but where calves of different ages occupy the same compartment, precautions must be taken to ensure that the weaker ones receive their proper ration or a fair share of the mixture. It may be necessary to provide each calf with its own food box and to tie up the animals while they consume their rations.

Other farmers introduce the milk substitute before the third week and discontinue the use of whole milk before the fifth. Home-bred calves that have had liberal supplies of colostrum and the milk of their dams for some days are better prepared for such treatment than young calves bought in the market, which are sometimes only a day old. These are difficult to rear in any case, but especially when no newly calved cow is available. The possibility of substituting milk early and the problems of rearing the bought calf can be understood only after further consideration of recent work on the part played by vitamins.

The Vitamins Question The calf is not born with a reserve of vitamin A but, given sufficient colostrum of high vitamin A potency, it rapidly builds up a level suitable for healthy development. If the cows have been unsuitably fed, their colostrum may not

meet that requirement and the calves develop white scour. Dunlop reported upon cases occurring in Derbyshire in the winter of 1938–39[3]. This question has also been studied in Scotland[4] and in America[5].

Another form of nutritional scour is due to deficiency in one of the members of the vitamin B complex. Our use of dried yeast for this purpose has already been mentioned. Lundquist and Phillips of Wisconsin have recently published the results of experiments which prove that it is the nicotinic acid factor which has the curative action[6]. Yeast and wheat bran are comparatively rich sources ; dried blood, an old remedy for scour in calves, is also rich in nicotinic acid and may owe its reputation to this property. Nicotinic acid can be bought in 50 mg. capsules, which are excellent for preventing or curing brown scour.

In attempting to rear calves on an artificial diet from birth, that is, without preparatory feeding on colostrum and milk, Lundquist and Phillips encountered susceptibility to peritonitis and other infectious diseases. On the diet first tried, skim milk plus vitamins A and D, the blood of the calves showed a rapid decline in vitamin C content, and the only survivor was one which had an abnormally high level of this vitamin at birth. Peritonitis was prevented in subsequent experiments by oral administration of 0.25 to 0.50 grams of ascorbic acid (vitamin C) daily for the first 10 or 12 days. These workers also found ascorbic acid highly effective in aiding the body defences against pneumonia and other infectious diseases and in the treatment of navel-ill. Unfortunately in calves older than 12 days oral administration is futile and injection is necessary.

During the first few weeks the health of the calf depends largely on its initial blood level of vitamin C and on that supplied by the food consumed during the first 10 or 12 days. Dried milk, for instance, is a poor source, and even colostrum and fresh milk may have a low vitamin C potency, especially after exposure to light. We have, however, demonstrated the possibility of rearing the young bought calf on milk substitute from the outset by oral dosing with medicinal preparations of vitamins A, B and C.

Dried skim milk, dried whey and dried yeast are not the only feeding-stuffs that can be used in compounding a milk substitute. Ground linseed and linseed cake meal have long been used, but they require special preparation and are not free from risk of prussic acid poisoning. In recent Nebraska experiments calves 3 weeks old made average weekly gains of 6 to 7 lb. on a mixture of 1 part dried blood to 3.2 parts dried whey[7].

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THE VALUE OF PROVEN SIRES

We are indebted to Mrs. G. M. Strutt, of the British Friesian Society, and Mr. K. Timberlake, Mr. J. S. Chivers and Mr. R. Kidner, of the Shorthorn Society, for the data used in this article.—*Ed.*

THE value of outstanding dairy sires of proven merit has never been more appreciated than at the present time when in the drive for livestock improvement so few can be found. This shortage of proven sires is due largely to the absence of a satisfactory and easily worked Progeny Testing Scheme, but this difficulty promises to be overcome by the Milk Marketing Board's Progeny Recording Scheme. There was also a disinclination on the part of breeders to retain bulls sufficiently long to prove their worth.

It is interesting to conjecture the loss to a breed of sires which although afterwards found to be of merit were slaughtered before their value was discovered. In this article a few examples are given of bulls of outstanding merit which were kept to a great age and had marked influence on their breeds.

Terling Marthus The first example is a British Friesian, "Terling (Imp. 1922) Marthus". Bred in South Africa, he was descended on both sides of his pedigree from the famous Dutch bull, "Ceres". This bull was purchased by Lord Rayleigh for 3,900 guineas in 1922 and was used extensively in the Terling herd for 14 years. His show career is interesting: in 1925 he won first and champion at the Royal, and first for the Progeny Class at the London Dairy Show in 1931. Many of Marthus's progeny have won prizes in the showyard all over England; all are noted for uniformity of type, being short-legged, deep-bodied animals, with the constitution that gives longevity. One of these, "Terling Torch 36th," is shown on p. iv of the art inset.

The milking qualities of his progeny and the breeding properties of the bull are remarkable; 123 first calf daughters averaged 10,602 lb. milk, 3.41 per cent. butter-fat; 115 second calvers averaged 13,796 lb. milk, 3.34 per cent. butter-fat; and 497 lactations of his daughters show an average of 13,757 lb. milk and 3.36 per cent. butter-fat. Included in the daughters are 35 which have given over 2,000 gallons in one lactation, 17 of which have given over 50 tons of milk in their life-time, and ancther which produced her sixteenth calf last year.

The sons of Marthus have been used in many herds, and nine of them have been responsible for 160 Register of Merit daughters.

Double Imperial The second example is that of a Dairy Shorthorn bull, "Double Imperial," bred by the late Mr. Joseph Timberlake at Hastoe Farm, Tring. "Double Imperial" was born on June 16, 1925, and was used for the greater part of his life in the herd of his breeder and later in the herd of Mr. L. Hignett at Checkendon, where he died at 13 years of age. In both herds he proved successful. His progeny included two Royal Show Champion cows, and many others of his daughters were prizewinners, both as individuals and as groups, at nearly every show of importance in the country. At least 39 of "Double Imperial's" daughters are known to have qualified by yielding up to the Shorthorn Society's standards; most of them gave over 8,000 lb. of milk with their first calves, and the majority went on to exceed 1,000 gallons at maturity. Not only

did "Double Imperial" sire outstanding females, but his son, "Imperial Roderick," used by Messrs. Hobbs at Kelmscott, sired "Kelmscott Marjory 47th"—R.A.S.E. Champion in 1936—and other prizewinners. Another son, "Hastoe Premier Fame 2nd," has sired over 30 qualified daughters—many of them prizewinners, including "Hastoe Barrington 30th" which was exported to Canada and has yielded over 84,000 lb. of milk in five lactations.

The breeding of "Double Imperial" is worthy of notice, his sire being "Lord Leicester 30th" that left over 40 qualified cows, while his dam, "Hastoe Broadhocks 4th," gave over 13,000 lb. in both her fourth and fifth lactations. On both sides he traces back to the great "George Taylor" cow, "Darlington Cranford 5th," through her sons, "Conjuror" and "Foundation Stone". It may be said that "Double Imperial" amply fulfilled the promise of his breeding, and this should encourage the study of pedigree by those farmers who are unable to obtain the use of proven bulls.

Wicklesham Darlington Prince 4th A photograph is shown of a group of Shorthorn cows all sired by the same bull, "Wicklesham Darlington Prince 4th," who at 9 years old is still in use. The impressive character of the sire is illustrated by the uniformity of type, and the milk records speak for themselves.

Deenewood Lord Oxford 12th Another example is that of a qualified dairy Shorthorn bull, "Deenewood Lord Oxford 12th," a Register of Merit bull which is still living. The three immediate sires were all Register of Merit bulls, and the bull's dam averaged 11,178 lb. of milk with her first three calves, her dam 9,685 lb. of milk for the first seven calves and the sire's dam 13,645 lb. of milk with her first seven calves. These are clear evidence of constitution and longevity. But the most valuable feature of this bull is that he has raised the milk records of his daughters by 1,061 lb. and butter-fat by 0.61 per cent. over their dams at comparable lactations. The comparative records of the daughters of the bull and their dams are given below:

Daughters 1st Calf Records			**Dams of Daughters**	**1st Calf Records**	
NAME	*lb. milk* 315 *days*	*Butter-fat per cent.*	*lb. milk* 315 *days*		*Butter-fat per cent.*
Histon Lady Gwynne	8,997	3.85	5,298		3.10
Histon Kirklevington 7th	6,422	4.41	5,586		3.95
224 days giving 22 lb. daily					
Histon Bessie 3rd	7,132	4.13	7,671	301 days	3.57
Histon Darlington 50th	7,423	3.72	3,887	265 days	3.33
Deenewood Waterloo 28th	8,345	4.30	6,662		Not tested
Histon Heroine 6th	7,883	4.03	6,937		3.72
Histon Waterloo 4th	6,750	3.97	6,312		Not tested
Histon Duchess Geneva 13th	6,680	3.99	7,449		3.36
Histon Musical Bouquet 5th	5,996	4.37	7,218		3.87
Daughters 2nd Calf Records			**Dam of Daughters**	**2nd Calf Records**	
Histon Wild Queen 70th	8,005	4.41	5,997		3.16
287 days giving 17 lb. daily					
AVERAGE	7,363	4.11	6,302		3.50
INCREASE OF DAUGHTERS OVER DAMS.	1,061 lb. milk	0.61 butter-fat each daughter	**Represents an average of 83 lb. of butter-fat per daughter.**		

POTATO HAULM KILLING

G. SAMUEL, M.Sc.

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ONE of the most interesting recent developments in potato-growing is the increase in the practice of killing off the haulm at the end of the season with sulphuric acid or other sprays. No accurate figures are available but there is little doubt that the acreage treated every year now runs into tens of thousands, and that were it not for the shortage of acid-resistant spraying machines the figure would be considerably higher.

It was less than ten years ago that Bates and Martin, and later Findlay and Sykes,* gave the first reports of experiments with the method in this country. They showed that the treatment reduced the proportion of blighted tubers developing in storage, when Blight was present on the haulm at lifting time. In this respect the treatment was thus essentially a new method of carrying out on a large scale what had formerly for a long time been done on a small scale in certain parts of the country—namely, removing blighted haulm, before lifting, by hand—usually with a long-handled sickle.

It was not long, however, before other advantages of killing the haulm by chemicals became apparent—for example, it permitted greater ease of lifting by machinery, especially when the haulm was very big; it was useful on certain soils where a rank growth of weeds followed destruction of the haulm by Blight; and it was valuable also for checking the growth of crops being raised for seed.

Value in Blight Control Probably the most important of these various uses of the method is that of guarding against infection of the tubers at lifting time. The practice is especially valuable in this country, where over large areas Blight usually comes so late in the season that fungicidal spraying to protect the haulm has never gained popularity, and where the main requirement is a means of ensuring that a sound crop of tubers can be lifted without danger of contamination from any Blight that may be present on the leaves at the end of the season.

The time when haulm killing is most important is when the tops remain green late, and when Blight spots on the leaves begin to sporulate freely in the cool dewy mornings of autumn. If a crop with the haulm in this condition is lifted without precautions, the tubers become showered with invisible Blight spores, and may later rot to the extent of 50 per cent. or more in the clamp. It is under conditions such as these that haulm burning may be the means of saving an entire crop.

There are still many potato growers who do not recognize the danger signal of Blight on the haulm at lifting time—a fact which is proved conclusively and all too frequently by the serious wastage in clamps that occurs whenever there is a wet autumn. It will be a great step forward when every grower has a proper appreciation of the life history of the Blight fungus and when, in consequence, it becomes a routine practice for him to examine his crop carefully before lifting. He should look for the faint white fringe of mould on the undersides of the leaves which indicates that

* *Jour. Min. Agric.* (1935) **42** 231, and (1936) **43** 457.

Blight is in its most dangerous sporulating stage, and realize that if conditions are damp he should have the haulm cut or burnt off in order to make lifting safe.

Setting of the Skins Even when the crop is free from Blight, haulm killing may be of value in removing tops which remain green very late, and in promoting the setting of the skins of the tubers. As long as tops remain green the tubers are growing and the skins do not set. Potatoes lifted in this condition are more apt to suffer skin injury than when they are properly "ripened," and as a result there may be some wastage in storage. Both practical and scientific evidence suggest that killing the haulm, which stops further growth, promotes the setting of the skins—at least in some varieties. This point is now being investigated in detail, but in the meantime it is probably safe to say that haulm killing, followed by a wait of 10 days or a fortnight before lifting, is the best treatment for crops that are still green at the end of September.

When Haulm Killing is Unnecessary There are at least two circumstances in which haulm killing is unnecessary, and when it may be a waste of money and material. The first is when the haulm begins to yellow and die off naturally before the end of September. This often happens in a dry autumn, especially with early maincrop varieties that have been planted in good time. Under such conditions, moreover, Blight is usually not troublesome. The second is when Blight itself kills off the haulm completely and fairly rapidly, so that nothing but dead haulm remains by lifting time. This is frequently seen in the West, where the rainfall is high, and in low-lying areas such as the fens, where heavy autumn mists favour the spread of the disease.

Some judgment and experience are required, however, to recognize the conditions when it is safe to let Blight completely kill the tops. The tubers must be well earthed up, and the soil must be one which does not allow the Blight spores to penetrate down to the tubers. On clay soils and on those that crack on drying there is danger of Blight infecting many tubers in the soil if the disease is present on the tops for long. Under such conditions it may not be safe to wait for Blight to kill the tops completely before lifting, and the correct thing to do is to have the tops burnt off as soon as the disease shows signs of becoming prevalent in the crop.

There is opportunity here for good judgment of the best time to burn off. Increase of Blight on the tops is not so dangerous when only light rains are experienced. A heavy rain, on the other hand, may carry the disease down into the soil and infect many tubers. On soils where Blight infection of the tubers is to be feared there is, therefore, great advantage in growers having their own spraying machines, so that if a heavy rain threatens in autumn, blighted haulm can quickly be burnt off as a precaution.

Burning-off Sprays Sulphuric acid is at present the most effective haulm-killing spray, but it has several disadvantages which render it unsuitable for general use by growers. Special acid-resistant spraying machines are required; the spray is ruinous to clothing; and transport in glass carboys is difficult. However, the acid is quite easily handled by men familiar with the work. The major part of the acreage burnt off with sulphuric acid is now done under contract or by large growers with staff accustomed to handling it.

Before the war sodium chlorate and calcium cyanamide were beginning to be used as substitutes for sulphuric acid, in order to surmount the disadvantages mentioned. Both became unobtainable on the outbreak of war, however, and search has been made for substitutes.

At present all these sprays must be applied diluted with water, and at a rate of 100 gal. or more per acre, according to the size of the haulm. The objects must be to obtain complete wetting of all leaves and stems.

Two substitutes that have proved themselves useful are : (1) a mixture of copper sulphate and salt (30 lb. powdered bluestone and 10 lb. salt per 100 gal. water) ; and (2) tar distillate washes, as used for the winter spraying of fruit trees. The main disadvantages of (1) are that it is not satisfactory on vigorously growing haulm at the stage when it has to be killed off by seed growers, and that, though it burns off the leaves quite well towards the end of the season, it does not destroy the stems as effectively as sulphuric acid. Tar distillate washes are satisfactory but slow in action, taking some 10–14 days to kill the leaves. They are also about three times as expensive as sulphuric acid.

New Sprays under Test Some experimental work is now being carried out by the Agricultural Research Council and the Chemical Research Laboratory of the Department of Scientific and Industrial Research in collaboration, with a view to developing quicker-acting sprays of the tar distillate type which would be suitable for use by growers who have no acid-resistant spraying machines or who dislike handling sulphuric acid. Two compounds showing some promise have been distributed this year for field test by a number of War Agricultural Executive Committees, and if these prove satisfactory they could be made available in quantity in future years.

Certain commercial firms have recently been developing machines suitable for atomizing undiluted sulphuric acid, and the saving of water carting which this permits is an important feature in those parts of the country where water is not readily obtainable. It is to be hoped that after the war there may be further developments of the process of atomizing sprays, since it is one that may prove particularly valuable for haulm killing.

One further point should be stressed. Killing off the haulm checks growth immediately, so that if the treatment is done too early the yield may be reduced appreciably. Even as late as September, crops with green haulm can put on more than half a ton of tubers per acre per week. Haulm killing is thus a process that requires to be used with discrimination—not too early, yet not too late. Indeed, in a season when Blight is prevalent it would be better to err, if anything, a little on the early side, rather than delay too long and find that a heavy rain has carried Blight down to the tubers.

There is no doubt that the method of chemical haulm killing is a most valuable aid in safeguarding tubers from infection with Blight at lifting time, especially in a wet autumn. Its use for this purpose is likely to increase rapidly in the near future, particularly in the North and West of the country, where the haulm of maincrops tends to last late in the season.

PURE SEED CROPS

JOHN D. PALMER

Chester

IF the standard of purity existing in cereal varieties being grown in this country is to be maintained, greater care must be taken in the growing of crops intended for seed purposes. Increased acreage, successive straw crops, and the retailing of seeds by local merchants who lack the required specialized knowledge, all contribute to admixture. Plant breeding stations and seedsmen who specialize in raising their own strains have found that too little attention is given by growers to the important operation of cleaning the machinery used for sowing and threshing.

Approximately one-tenth of the total quantity of grain grown in this country is used for seed purposes, and it is therefore of paramount importance that every farmer who grows these crops should not only be supplied with pure stock seed, but he should also exercise the greatest possible care to ensure that from the time the seed is received by him until the crop is delivered there is no possibility of admixture taking place on his farm.

To ensure that the crop is sown on absolutely clean land the seedsman makes a condition in his contract that the previous crop should not have been oats, wheat, barley, rye, vetches, or pulse crops. He also ensures that straw has not previously been used on the field for either stack bottoms or potato clamps. It is relatively easy to make certain that this part of the agreement is carried out, but guidance is often needed in the cleaning of the drill and threshing machine.

Experienced inspectors have reported, when visiting crops at harvest-time, that in many fields the percentage of "rogues" present is considerably higher in the strip where drilling has commenced. This points to neglect on the part of the farmer or drillman to clean his machine before starting to sow a fresh variety, and provides us with the first of our problems.

The second and more serious means of contaminating pure stocks of grain with "rogues" is the farm threshing machine. Its mechanism is complicated, and the interior contains numerous holes and corners where grain can be trapped and subsequently shaken out to contaminate an otherwise pure stock of seed.

The cleaning of both farm drills and threshing machines is practicable, but the job must be tackled methodically and a few simple rules followed. The following notes are based on practical experience, and may provide useful guidance to growers of seed crops.

Cleaning of Corn Drills The tools necessary for cleaning corn drills are the normal tool kit supplied with the machine, a small hand brush, one or two pieces of stiff galvanized wire, a small knife with a thin blade, and a short length of 8-mm. rubber tubing.

The procedure for cleaning the machine is to start with the grain hopper and work down to the coulters. If the machine is to be cleaned near the field to be sown, a sheet should be spread underneath the spouts to catch the grain. Alternatively the work should be carried out on a clean, flat piece of ground, so that grain ejected can be swept up. Certain types of drills have lids on the grain hopper which can be used as a trough for catching the grain.

First, sweep all grain from the sides and corners of the grain hopper down into the feed cups. All grain should be removed from the corners of the hopper by means of the knife blade. Second, slacken the spring-mounted plates at the bottom of the feed cups (if fitted) ; this will enable most of the grain to run out into the flexible tubes. Grain remaining in the bottom of the feed cups can be ejected by blowing through the piece of rubber tubing, or using a bicycle pump, passing a strong current of air through the bottom of each in turn. These operations should thoroughly clean the hopper and feed mechanism. If difficulty is experienced in emptying the grain hopper, the drill should be turned completely over on to a sheet.

If the hopper contains much grain it should be ejected by rotating the feed cogs. Some machines have a cranked handle which can be used to turn the square shaft on which the feed wheels are mounted. As this rotates the seed will be ejected into the spouts. If the machine is not provided with a means of rotating the feed gear, jack up the drill so that it is off the road wheels and, with the sowing mechanism in gear, rotate the wheels by hand until all grain present in the feed cups has been ejected.

Next, detach the flexible conductors at the bottom, shake out any trapped grain and pull a piece of paraffined rag through each conductor.

All that is then necessary is a final check over to ensure that there is no grain sticking to the external portions of the machine, particularly to the grease exuded from the bearings.

Cleaning Threshing Machines The efficiency of the threshing machine is admittedly extremely high and reflects the great care and craftsmanship which have been put into its construction, but generally speaking its cleaning is a rather difficult operation. Certainly owners do not give sufficient attention to this matter. Before commencing work on a crop which has been grown for seed, it is essential that the farmer should clean down his machine to get rid of all grain from a previous threshing. In spite of difficulties of access to internal parts, the job can be done efficiently, provided the work is carried out in a proper sequence.

Cleaning the machine should preferably be carried out after completing the threshing of one crop and before proceeding to a new site. This, however, is not always possible. Threshing contractors will be unlikely to give time to cleaning unless especially asked to do so by the grower. Farmers should always satisfy themselves that the machine has been thoroughly cleaned before work on a seed crop is started.

In addition to the tool kit supplied by the manufacturers, the following tools are essential to deal efficiently with the cleaning of a threshing machine : a wire brush, a couple of brooms, hand brushes, short lengths of stiff galvanized wire and a thin-bladed knife. Incidentally a pair of bellows is extremely helpful for dislodging grain from awkward corners, and a hack-saw blade will be found very useful for removing grain lodged between the side of the concave and the framework of the machine. Some contractors have a habit of carrying their tools and odd bags of chaff, etc. on top of the box ; all these items should be removed before starting to clean. A start should be made by thoroughly cleaning the outside of the machine and brushing all grain from the top of it. Care must be taken to see that the drum mouth is closed if the machine is running.

Run the machine empty for a short time at a speed slightly lower than the normal for threshing. This will allow grain to be dislodged and will also eject any material lying on the sieves or shoes.

Open the shutter at the bottom of the elevator and allow any surplus grain to come out of the opening. At the same time extend the rotary screen to its full extent and hold a wire brush against the rotating drum; this will thoroughly clean the wire screen.

After the machine has been running for five minutes, it should be stopped and cleaning commenced at the top.

First, the self-feeder (if fitted) should be attended to, followed by the drum, particular attention being given to the beater bars and the concave. The straw shakers must be very carefully cleaned, and all grain lying on them brushed down on to the long shoe. Attention should then be given to the shoes themselves, and all grain swept down on to the cavings riddle. The latter is then removed and cleaned, the grain being swept down to the short shoe. The bottom sieves must be removed in turn and thoroughly cleaned with a wire brush. The short lengths of wire will be found useful for removing grain from awkward corners.

The grain which has accumulated is then swept out of either the chaff spout or the aperture at the bottom of the small seed or sand riddle.

Next rotate the elevator by hand and see that all grain is removed from the cups and belting.

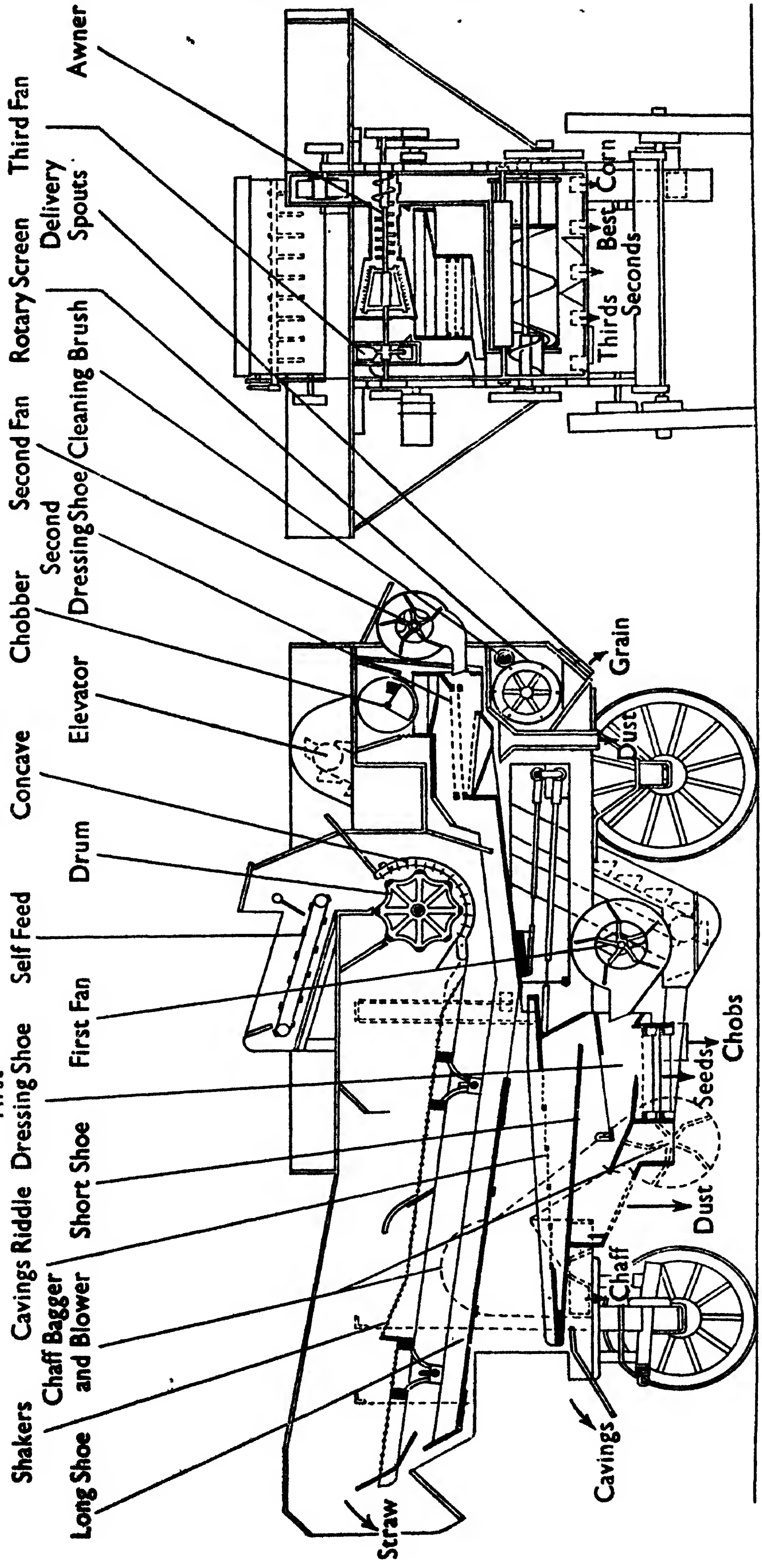
ATTENTION TO THE AWNER Probably the most difficult operation is the cleaning of the awner, but it is possible on some machines to remove the covers and brush out the inside. In most cases a door is provided to allow adjustment to be made to the setting. This should be opened and the grain inside brushed out. If a conveyor worm is fitted for delivering corn into the awner, this can be cleaned by inserting a wad of cotton waste and turning the spindle. This procedure will clear any seeds remaining in the conveyor barrel. The shaft can be turned by hand if the belts are taken off. Always make certain that the cotton waste is removed.

Detach the second dressing shoe and thoroughly clean the inside of the surrounding woodwork. The grain will then pass down from the second dressing shoe into the rotary screen. This screen consists of a periphery of expanding wires, and it is important that it should not be closed until all grain has been removed. Particular attention should be paid to the cleaning of the rotary screen box, and all grain must be dislodged from the partition which divides each grain outlet.

All ledges and woodwork on the inside of the machine must be swept clear of dust and accumulated grain.

After these operations have been carried out and the machine has been re-assembled, it should be run empty for a few minutes. Open the shutter at the bottom of the elevator and see that all fan slides are fully open, and for one short period increase the speed to twice normal. Finally, readjust all fan slides and the rotary screen to their working positions.

Clean Machines mean Pure Seed A threshing machine which has been properly maintained can be cleaned in a relatively short time, whereas one which has been neglected presents a difficult problem. The correct adjustment and setting of the machine is



THRESHING MACHINE

extremely important, and full use should be made of all riddles. By using riddles which are too small a choked box will result, making cleaning difficult.

Periodically accumulations of dust and grease must be scraped from the woodwork adjacent to any bearings. Finally, do not thresh when the grain is wet. Wet grain is difficult to remove.

When threshing for seed it is always advisable to remove and keep separate the first few bags off the machine.

SPADE LUGS

National Institute of Agricultural Engineering, Askham Bryan, York

MUCH fuel is wasted and power lost by tractors with worn, broken, or missing spade lugs. It is not always appreciated that worn lugs lead to waste of fuel through "wheel slip," which usually passes unnoticed. The wheels of any tractor pulling a heavy load (as in ploughing) slip to some extent even on firm footing, and if the spade lugs are worn, wheel slip will reach serious proportions.

Wheel slip is a less noticeable form of the more obvious "wheel spin". For example, if no slip occurs the wheels might turn seven times to move the tractor 100 ft.; the same wheels with worn lugs might only move the tractor 70 ft. when they turn seven times. Thus 30 ft. of the possible travel have been lost; or, to put it another way, the slip is 30 ft. in 100—that is, 30 per cent. It takes the same amount of fuel per hour to drive the engine however much the wheel is slipping, and the more it slips the longer the tractor takes to cover the same distance—that is, to do the same amount of work. The result is that the tractor may use as much as an extra gallon of fuel per acre with no useful return.

If you are in doubt whether your spade lugs are so worn that it is wasteful to go on using them, the following test will show the amount of slip prevailing:

Mark a spoke on one rear wheel of the tractor (the land wheel when ploughing), and when at work pace out the distance the tractor travels for ten revolutions of the rear wheel. Unhitch the tractor and repeat the run with no load, again pacing the distance travelled for ten revolutions of the wheel. The percentage of slip is then approximately:

$$\frac{\text{Paces covered running light, minus paces covered when loaded} \times 100}{\text{Paces covered running light}}$$

If the figure obtained exceeds 15 per cent. on reasonably firm footing, the spade lugs should be replaced with new ones. If worn lugs are not the cause you should consult your County Machinery Instructor, who will be able to advise you.

FARMING NOTES

Seventy-one Calves Reared on Three Cows

The possibilities of economical calf-rearing have been shown by a Wiltshire farmer who reared 71 calves on 3 cows during 16 weeks last winter. Shorthorn heifer calves of good type were bought in batches at local markets between October 19 and January 25 at an average cost of £5 1s. Their average age was about one week. Two of the nurse cows

which were freshly calved each suckled 4 calves at a time, and the other cow had enough milk for 2–3 calves at a time. It is estimated that the calves had an average of 12 gallons of milk each during the fortnight or so they were on the cows.

With this short allowance of milk the calves were soon ready to start picking at calf meal in troughs, and meadow hay and a bunch of kale hung in the pen. Generally the calves started to eat their own food at 10–14 days, and all were weaned after 3 weeks—that is to say, when they were about a month old.

They were then moved to a Dutch barn with an outrun into a yard built of straw bales 6 ft. high, where they were fed calf nuts and crushed oats with seeds hay and kale. In the New Year the kale was replaced by mangolds for the older calves. All the calves went out to grass in May, and the feeding of calf nuts and oats was gradually reduced until by mid-July only 25 of the younger calves were getting any concentrates. By this time the calf-food coupons were almost exhausted. All the calves will be brought into straw yards in September to be carried through the winter on seeds hay, kale and then swedes and mangolds.

The Wiltshire Executive Officer who saw the calves at pasture in late July expressed the opinion that they were a very useful lot, well grown for age and in the right condition to make sound heifers for the dairy herd. The Executive Officer, who has been in touch with the system as practised on this farm during the past ten years, states that this is an economical and easy method of rearing and has the great advantage of dealing with relatively large numbers—an important point in relation to the future of the livestock industry; further, it makes for great economy in the use of milk.

Agricultural Improvement Council for England and Wales: Increased Membership and Wider Terms of Reference

The Agricultural Improvement Council for England and Wales was set up by the Minister of Agriculture on June 12, 1941. Its object was to promote closer contact between the farmer and the scientist with a view to ensuring the greatest possible application of the results of scientific research and new technical methods to ordinary farming practice. The members of the Council were appointed in the first instance for a period of three years.

In spite of the many difficulties of the last three years, the Council has done valuable work, and the Minister has decided to establish it on a more permanent basis, with an increased membership and widened terms of reference.

It is proposed, in order to prevent the membership of the Council from becoming static, that individual appointments shall be for a period of three years, with the possibility of such reappointments for a further period as may be necessary to preserve continuity in the work.

The members now appointed are: Sir Donald Fergusson, K.C.B. (Chairman), Mr. Dennis Brown, Mr. T. Dalling, M.A., M.R.C.V.S., Professor Sir Frank Engledow, C.M.G., Mr. J. C. F. Fryer, O.B.E., Mr. A. Holness, Mr. A. R. Hurd, Mr. C. Bryner Jones, C.B., C.B.E., Mr. D. Lewis, Mr. T. Neame, Mr. C. Neville, Mr. F. Rayns, O.B.E., Dr. E. J. Salisbury, C.B.E., F.R.S., Mr. F. A. Secrett, Mr. J. Turner and Professor J. A. Scott Watson.

Mr. Fryer, who has acted as secretary, has resigned his position on his appointment as Secretary of the Agricultural Research Council, and he

is succeeded by Dr. W. K. Slater, F.R.I.C., who has been assisting him as Chief Technical Officer, and Mr. C. F. Whittington has been appointed Assistant Secretary.

The expanded terms of reference of the Council are as follows:

> To keep under review the progress of research with a view to ensuring that promising results are applied as rapidly as possible to the problems of agriculture and horticulture, and that these and any other new technical methods are incorporated into ordinary commercial practice; to advise from time to time concerning agricultural and horticultural problems which appear to require scientific investigation; and to advise generally as to the lines on which a policy designed to raise the technical standard of agricultural and horticultural production can best be implemented.

The address of the Council is Block 4 Bickenhall Mansions, London, W.1.

Order Seed Potatoes Early Transport will again be difficult this winter and growers are advised to order their seed potatoes early and, where possible, to take delivery early. The higher seed riddles are still in force, so that from 20–25 cwt. or more of seed, according to the variety, may be required to plant an acre.

Wider Rotation to Avoid Eelworm In choosing the site of next year's potato field, it should be remembered that potatoes like a deep well-drained soil, and also that too close a rotation may favour the attention of eelworm. The potato root eelworm, if allowed to develop to the stage of affecting the growth of haulm, will spoil the land for potato-growing for a number of years. Potatoes should not, therefore, be planted in a field that has grown potatoes during the last two years. If possible, a rotation carrying potatoes once in four years or more—should be adopted.

Seed Potatoes: New Classification The attention of all seed potato merchants and growers is drawn to the Seeds (Amendment) Regulations, 1944, which set out the particulars that must be stated on every sale or exposure for sale of seed potatoes in England and Wales as from August 1, 1944.

The previous requirements that the seller must state his name and address, and the variety, size and dressing, remain unchanged, but the Regulations lay down a new classification for seed potatoes based on the health of the stock as evidenced by official certificates issued by one or other of the Agricultural Departments in the United Kingdom and Eire after inspection of the growing crop. The new classification is divided into 3 groups: (1) "certified"; (2) uncertified (English or Welsh once-grown)—an intermediate group for seed potatoes obtained from an uncertified crop which was grown in England and Wales from a "certified" stock; and (3) "uncertified". In the case of the "certified" classes, the reference letters and number of the relative certificate must be quoted. The full classification is:

Certified (Scotch), Certified (Northern Ireland), Certified (Eire), Certified (English), Certified (Welsh), Certified (Isle of Man); Uncertified (English once-grown), Uncertified (Welsh once-grown); Uncertified (Scotch), Uncertified (English) and Uncertified (Welsh). The various classes are defined in the Regulations. Copies of the Regulations (S. R. & O. 1944, No. 926) are obtainable from H.M. Stationery Office, York House, Kingsway, W.C. 2., or through any bookseller, price 1d. net.

All the Agricultural Departments in the United Kingdom and Eire have now adopted the same system of designations for the certificates mentioned above. First, the grade of certificate is shown by "SS" (Stock seed), "A" (first quality commercial seed) or "H" (healthy commercial

seed); next, the country of origin is indicated by an abbreviation in brackets thus, Scotland "(Scot)", England "(E"), Wales "(W)", Northern Ireland "(Nor.Ir.)", Eire "(Eire)" or Isle of Man "(I.O.M.)"; and, finally, "N.I." is added in the case of those varieties which are not approved as immune from Wart Disease.

Thus, for example, a certificate designated "A (Scot)" would indicate seed potatoes of first quality commercial standard grown in Scotland and of a variety immune from Wart Disease; "H (E) N.I.", healthy commercial seed potatoes grown in England but of a variety not approved as immune from Wart Disease.

AGRICULTURAL INDEX NUMBER

MONTHLY INDEX NUMBERS OF PRICES OF AGRICULTURAL PRODUCE INCLUDING GOVERNMENT PAYMENTS* (BASE, 1927–29 = 100)

	Uncorrected for Seasonal Variation					*Corrected for Seasonal Variation*				
Month	1939	1941	1942	1943	1944	1939	1941	1942	1943	1944
January ..	95	149	175	181†	189†	*89*	*137*	*161*	*166†*	*171†*
February	94	144	178	179†	187†	*88*	*135*	*167*	*167†*	*172†*
March ..	91	143	176	174†	182†	*91*	*144*	*178*	*173†*	*177†*
April ..	90	138	161	157†	163†	*95*	*145*	*171*	*165†*	*170†*
May ..	82	130	154	149†	150†	*91*	*147*	*174*	*167†*	*170†*
June ..	80	129	152†	148†	149†	*89*	*145*	*171†*	*165†*	*169†*
July ..	85	137	155†	153†		*93*	*148*	*168†*	*165†*	
August ..	86	140	152†	152†		*91*	*148*	*160†*	*160†*	
September	92	139	147†	147†		*93*	*142*	*150†*	*151†*	
October ..	96	154	164†	163†		*92*	*147*	*156†*	*156†*	
November	106	162	174†	173†		*98*	*149*	*161†*	*160†*	
December	113	168	179†	182†		*103*	*152*	*162†*	*165†*	

* Certain indices since January, 1939, have been revised, owing to the inclusion of subsidy in the cheese index price.

† Provisional.

THE MINISTRY'S PUBLICATIONS

Since the date of the list published in the June issue of this JOURNAL (p. 143), the undermentioned publications have been issued:

Bulletins Copies are obtainable at the price mentioned from the Sales Offices of H.M. Stationery Office or through any bookseller.

No. 85. Rotations (*Rewritten*). 4d. net (5d. by post).

Advisory Leaflets Single copies of not more than 16 leaflets may be obtained, free of charge, on application to the Ministry, Berri Court Hotel, St. Annes-on-Sea, Lancs. Copies beyond this limit must be purchased from the Sales Offices of H.M. Stationery Office, price 1d. each net (2d. by post), or 9d. net per doz. (11d. by post).

No. 18. Cabbage Root Fly (*Revised*).
No. 27. Black Currant Gall Mite (*Revised*).
No. 40. Small Ermine Moths (*Rewritten*).
No. 89. Couch or Twitch (*Reissued*).
No. 232. Liquid Manure Tanks (*Revised*).
No. 261. Onion and Leek Smut (*Revised*).
No. 286. Chrysanthemum Midge (*Rewritten*).
No. 319. Soil Sterilization (*New*).

THE MINISTRY'S PUBLICATIONS

"Growmore" Leaflets Single copies of these leaflets may be obtained free on application to the Ministry only (copies are not obtainable from H.M. Stationery Office). The following further issues are now available:

No. 3. Making the Most of Potash Supplies (*Revised*).
No. 13. Linseed as a Home-grown Crop (*Revised*).
No. 27. Kale for Winter Feed (*Revised*).
No. 39. Acorns and Beech Mast as Feeding Stuffs (*Revised*).
No. 40. Ensiling Sugar-beet Tops (*Revised*).
No. 90. Trichomonas Disease* (*New*).

NOTICE OF BOOK

The Production of Seed of Root Crops and Vegetables. (I.A.B. Joint Publication No. 5). IMPERIAL AGRICULTURAL BUREAUX. Aberystwyth. 1943. 3*s*.

Not least has the impact of war been felt in the sphere of seed production. The publication under review gives an indication of the problems of a number of countries in maintaining a supply of seeds under war-time conditions; also some interesting details of the pre-war activities and requirements of several countries, and a good account of root and vegetable seed production in the United Kingdom.

The account of state sealing with control cultivation which is being carried out in Sweden shows that the importance of good seed has been duly recognized, and is an example worth studying. The story of sugar-beet production in the U.S.A., where ten years sufficed to effect a change-over from total reliance on imports to self-sufficiency (18,000,000 lb. annual production) is a striking example of the joint achievements of science and commerce.

Before the war Australia, Canada and New Zealand relied on imports from the United Kingdom for a great deal of seed, but the curtailment of these supplies, due to the need of using every available acre of our island for food production, has made the development of seed-growing a vital necessity. Some seed-growing took place in the Dominions before the war, but present conditions have led to a considerable expansion.

Considering that the supply of seeds is at all times so vital to the needs of any nation, it is surprising that there is very little literature on the subject, and whilst this excellent bulletin gives interesting and valuable information, it is to be hoped that before long a really full account of all aspects of seed production will be forthcoming.

Anyone who is interested in seed production will find it worth while to obtain this bulletin.

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* Replaces Advisory Leaflet No. 314.

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BREEDING FOR MILK AT BELTSVILLE, WASHINGTON, D.C.

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IN any consideration of the post-war structure of agriculture in various countries, it is becoming increasingly evident that the nutritional requirements of the people must be of pre-eminent importance. In Britain war-time feeding has been devised as far as possible on the basis of nutritional requirements and, in consequence, a high priority has been given to milk production. Also, the introduction of a scheme for priority consumers—children, expectant and nursing mothers, etc.—has ensured that an adequate supply of milk is provided for those members of the community who most need it. It is true that our *per capita* consumption of liquid milk before the war, although higher than that in many European countries, was much lower than that of the Scandinavian countries or of the United States of America. Nutrition experts have estimated that for optimum nutrition our consumption of liquid milk should be raised to a national average of about twice the pre-war figure. If milk consumption is to be doubled, or at least considerably increased, in a relatively short time, it means that because of our limited land resources, while some part of that increase may come from an increased number of cows, it is essential to intensify all possible measures to increase the yield per cow.

Importance of the Herd Sire More emphasis is gradually again being placed on the livestock side of farming, and measures for the general improvement of dairy herds and for the adoption by all dairy farmers of a breeding policy are being energetically pursued. No one policy, however, will be suitable for all conditions. Many farmers will aim at the ideal of a self-contained herd, with the advantages of comparative freedom from disease which should accompany it. This ideal is, however, impossible and impracticable unless milk yields can be maintained or increased. Unless the home-bred heifers, when they join the milkers in the cowsheds, prove to be in the aggregate as good milkers as their dams, or better, then the milk output from the farm must fall and the whole financial structure of the dairy farm is jeopardized.

This maintenance of milk yields, assuming feeding and general management to be efficient, depends primarily on the purchase of suitable bulls. The purchase of a herd sire is, or should be, a matter of the first importance to any dairy farmer ; to the owner of a self-contained herd it is fundamental. The only true economic assessment of the value of a dairy bull is the milk yield of his daughters. The valuable bull in a dairy herd is one who has demonstrated his ability to transmit to his daughters the capacity to produce milk and butter-fat on a level equal to, or higher than, that of their dams. The terms "proven sire" or "progeny-tested sire" are commonly applied to such bulls, but it is obvious that such descriptions must be used only when they are fully justified by an examination of all records on an unselected basis, and on an examination of all available progeny. It must also be realized that the term "proven sire" as used in this context applies only to the ability to transmit milk and butter-fat ; there may be other factors, such as size, quality of udder, etc., which should be taken into consideration.

The supply of proven sires is small, and from a national point of view it is desirable that the services of such outstanding dairy bulls should be made as widely available as possible. Artificial insemination is the great possibility in this direction. Where a dairy farmer prefers to have his own herd sire, first choice should be given to a proven sire, but where, as in most cases, this is not possible, then part of the inevitable gamble attached to the purchase of a young bull may be reduced if the youngster is the son of a proven sire, and still further if his dam is also the progeny of a proven sire.

The writer recently had the opportunity of visiting the Government Research Centre at Beltsville, near Washington, D.C., where long-term experiments in dairy cattle improvement have been carried out since 1919. As these experiments have a direct bearing on the points briefly discussed in this introduction, it is thought that a summary of the results obtained to date may be of interest to dairy farmers and others interested in milk production.

Dairy Cattle Improvement Experiments at Beltsville The experiments at Beltsville Research Centre have been carried out under the direction and control of R. R. Graves and M. H. Fohrman of the Division of Dairy Cattle Breeding, Bureau of Dairy Industry. Two breeds of cattle, Holstein-Friesian and Jersey, have been used, but for the sake of clarity and brevity it is proposed to deal here only with the results obtained from the Holstein-Friesian herd. Similar results have been obtained from both herds, but with the Holstein-Friesian the experiment has run longer and the numbers are larger.

The plan of the experiment with Holstein-Friesian cattle was to attempt to develop a strain that would steadily approach homozygosity (purity) in its inheritance for a high level of milk and butter-fat production by the continuous use of unrelated proven sires. Care was taken in the selection of the sires to avoid any inbreeding by the intentional purchase of bulls unrelated to their predecessors.

General Conditions Every effort has been made to provide conditions of continuously uniform environment and management. The milk and butter-fat production are recorded under standardized conditions, and they may fairly be regarded as optimum. All cows are put on test at the first calving, if calving is normal, and again when they reach mature age—about six years. If the first calving is abnormal, or something interferes with the first test, another record is started at the next calving. During the lactation periods between the first and last records the cows are bred for yearly calving and are frequently used on experimental feeding trials. When the experiment was started it was decided that the test period should be 365 days and that the cows should be served to calve again at 14 months from the previous calving. It has been stated that if the experiment were being designed now, a 305-days test period would be adopted, because it is considered that there would be less breeding trouble with cows calving at 12-months instead of 14-months interval. However, to maintain standardization no changes in technique have been made since the experiment started.

While on test the cows are in box-stalls, milked three times daily and fed according to size and production. Cows are not allowed out on pasture during the test year. Pasture at Beltsville varies widely and, as there is no assurance of adequate pasturage from year to year, and also because there is no accurate method of determining the amount of nutrients secured from grass when other rations are being fed during the grazing season, it was decided to keep the cows away from grazing during the test period. Exercise is allowed in a dry lot (bare yard). Feeding consists of alfalfa (lucerne) hay, corn (maize) silage and a mixture of dried beet pulp and grain mixture in the proportion of 1 to 4 (digestible protein content 15.5 per cent.). An attempt is made to feed each cow approximately 10 per cent. more nutrients than her calculated requirements, so that a low production may not be attributed to a limited feed. All cows are offered rather more hay and silage than they will consume, and the grain ration is apportioned to make up the rest of the nutrients required for maintenance and production. No "high-powered" feeding methods are practised and no effort is made to pamper individual animals with special feeds.

Foundation Cows The foundation cows were drawn from four groups. Group 1 consisted of females which were selected for purchase because of their close descent from well-known sires of that day and whose daughters were attracting attention by their high records of milk and butter-fat production. Group 2 consisted of the female progeny of those animals in Group 1 which were in calf at the time of purchase. Group 3 consisted of three daughters of a particular bull that were bred at Beltsville and two grand-daughters of the same sire. Group 4 consisted of the daughters of miscellaneous bulls used at Beltsville that were mated to various foundation cows before the experiment was begun. These groups totalled forty-one cows, and the production records of thirty-four were obtained to start the experiment. Of this number, nineteen were from Group 1, four each from Groups 2 and 3 and seven from Group 4.

The average records (age-corrected) of the thirty-four selected foundation cows were 19,966 lb. milk with a butter-fat of 3.4 per cent. or 678 lb.

Which Record to Use ? It is pointed out by the investigators that various records may be used to measure producing ability. For example, in a commercial herd, where the sale of milk is the source of income, the animal that has a good lifetime production will be more profitable than the animal which is a good producer for only one or two lactations. Where an analysis of the inheritance of producing ability is sought, it seems essential to use the standard most nearly free from interference by environmental factors. Lifetime production may be affected by breeding troubles, improper feeding, damage to udder, or other injuries—none of which has anything to do with inheritance for level of production.

It has already been explained that the procedure in this experiment is to test all cows with their first calf and to make a second record after the cow has reached the age of mature production. Again, there were various methods by which these records might be compared, but after full consideration it was deemed best to use the highest records in all cases, either actual mature records or the immature records, calculated to maturity, in the statistical analysis of the data.

During the progress of the experiment there has been no selection whatever, and *all* females have been reared and tested regardless of type or ability. The results given are on such unselected groups. Six sires have now been used, and the results are summarized in Table 1.

Table 1

	Selected Foundation Cows	Daughters of					
		Sire 1	Sire 2	Sire 3	Sire 4	Sire 5	Sire 6
Number	34	33	31	9*	5	50	12
Average† milk-yield (*lb.*)	19,966	19,059	19,794	16,504	20,904	20,463	20,533
Average Butter-fat percentage	3.40	3.49	3 57	3.95	3.78	3.99	3.79
Average Butter-fat (*lb.*)	678	663	705	659	790	817	775

* Two of the nine were abnormal and made extremely low yields, but they are included in the average.
† All records are age-corrected.

Sire No. 1—total daughters 33 ; none left in the herd
Sire No. 2— „ „ 31 ; „ „ „
Sire No. 3— „ „ 9 ; „ „ „
Sire No. 4— „ „ 5 ; „ „ „
Sire No. 5— „ „ 64 ; 31 left in the herd (April, 1944)
Production records from 50 daughters to date

Sire No. 6 (in service) } total daughters 52 ; 46 still in the herd (April, 1944) : production records from 12 daughters to date

Table 2 shows the distribution of the production records, milk and butter-fat, for 30 of the daughters of Sire 5 which are still in the herd.

The top yield was 25,108 lb. of milk of 4.33 per cent. equivalent to 1,088 lb. butter-fat, and the lowest yield was 10,743 lb. of milk of 3.63 per cent. equivalent to 390 lb. butter-fat.

Table 2

Milk Yields	Number of Cows	Butter-Fat Production	Number of Cows
lb.		*lb.*	
10,000—12,000	3	Under 400	1
12,000—14,000	2	400 — 600	9
14,000—16,000	8	600 — 800	12
16,000—18,000	4	800—1,000	7
18,000—20,000	6	Over 1,000	1
20,000—22,000	2		
22,000—24,000	4		
24,000—26,000	1		
	30		30

Discussion of Results Table 1 provides evidence that some degree of homozygosity in the inheritance for the factors of high milk and butter-fat production has been achieved. The thirty-four carefully selected foundation cows had a very high level of milk production and, considering those yields, a very creditable butter-fat production. During the twenty-five years since the experiment was started, the high milk yields, on a non-selected basis, have been consistently maintained by each successive herd sire, and in the aggregate even slightly increased. The apparent exception in the case of Sire 3 is footnoted in the Table.

Turning to the butter-fat figures there is observable a remarkable increase in the production achieved, along with a maintenance of the high yield figures. The six proven bulls have 140 daughters with records averaging 741 lb. of butter-fat. The 34 foundation females average 678 lb. of butter-fat and the 47 cows at present in the herd old enough to have completed records averaged 824 lb. of butter-fat. These summarized figures are on a mature basis.

Table 2 shows that the majority of the daughters of Sire 5 come in the centre of the spread. On milk yield, for example, 60 per cent. of them lie within the range of 14,000 to 20,000 lb., and the result is similar on a butter-fat basis. When the writer had the opportunity of examining the full details at Beltsville, it was very clear that as this work had progressed over the years the spread for the production figures had become consistently more concentrated, with fewer yields being above or below. This again, it is considered, is evidence of the degree of homozygosity achieved.

No dairy farmer or breeder will be satisfied with figures alone, and the writer spent the greater part of a day examining the herd. All animals were seen—cows, heifers, calves and stock bulls—and they all stood up to inspection. The cows could be classified as a high average with some really outstanding animals. True there was some variation in quality of udder, and one bull had left many of his daughters with a small hump on the back. While in the selection of a bull for purchase the proven sire with high-producing daughters is the overriding basis of decision, as much attention as possible is given to such factors as quality of udder, size,

etc. These proven sires must be bought in at advanced ages, and great care is taken to maintain them in a state of breeding efficiency. The bulls are housed in single, small pens and exercised daily for two hours. Eight mature bulls were undergoing this exercise at the time of inspection. The method employed is a rotating exerciser to which the bulls were attached. Mr. Fohrman does not favour the power-driven type, and instead uses two of the bulls being exercised as "yoke" bulls. A stockman was stationed at the central point with a whip, but his voice appeared to be sufficient to restart the procession whenever it stopped.

Line-breeding Investigation The general experiment was designed to afford a comparison of line-breeding with outbreeding. The line-bred groups were produced by mating sons of the proven sires to the half-sisters of their dams (relationship of nephew to aunt). In this manner outbred groups and line-bred groups would come from the same dams. To illustrate, the daughters of Sire 1 would be bred to unrelated Sire 2, and the progeny would be the outbred group. At later matings these same daughters of Sire 1 would be bred to a son of Sire 2 that was out of a daughter of Sire 1, the resulting progeny thus being a line-bred group obtained by the mating of nephew to aunts. The results so far have given average production yields of about the same order, but no better than those obtained by outbreeding. It must be remembered that, as previously indicated, the production tests are carried out under optimum conditions and the inbred groups might not have fared so well on an ordinary farm. Numbers of them are notably smaller than the outbred animals, and the general impression formed was that they were less robust. Inbreeding is a job for the specialist, who must be in a financial position to carry the possible risk. To the writer the main point of interest was that it had not produced, even when measured only in terms of milk and butter-fat production, any better results than the form of outbreeding described in this experiment.

It would seem, therefore, that where one has proved bulls, the necessity for line-breeding is not as great as under conditions where proved bulls are almost unobtainable.

The Jersey Herd It is not proposed to give detailed figures for the Jersey herd, but that similar results have been obtained can be seen from the following summary. The forty-three foundation Jersey cows averaged 622 lb. of butter-fat, while the thirty-seven Jerseys now in the herd and old enough to have completed records averaged 776 lb. of butter-fat. The twelve proved Jersey sires have 127 daughters with an average of 726 lb. of butter-fat.

These summarized figures are on a mature basis.

Sons of Proven Sires Young sons of these proven sires have been placed for service in co-operating herds in order to test their transmitting ability. Most of these herds are entered in dairy herd improvement work, and the bulls were proved under the conditions laid down by the Dairy Herd Improvement Associations (D.H.I.A.). Some have been used in institution's herds where the cows are milked three times daily, others in commercial herds where twice daily milking is the practice. These bulls are usually about seven years of age when the first proof comes in, so that the available proof to date does not include any

bulls born after 1938. The following Table includes the last summarized information on all of the Beltsville bulls that have been proved:

78 Holstein Friesian sires (58 increased butter-fat production)

	Milk	Butter-fat	
	lb.	*per cent.*	*lb.*
1,275 daughters averaged ..	13,114	3·55	464
1,275 dams averaged	12,327	3·50	429
Increase	787	0·05	35

70 Jersey sires (56 increased butter-fat production)

	Milk	Butter-fat	
	lb.	*per cent.*	*lb.*
970 daughters averaged	8,377	5·46	436
970 dams averaged	7,962	5·32	408
Increase	415	0·14	28

References The description of this experiment is based on the writer's visit to Beltsville, his inspection of the dairy herds and his discussions with Mr. Fohrman. The figures given are taken from a mimeographed report, *Outline of Dairy Cattle Breeding Projects* (revised April 3, 1944). Some additional information has been taken from United States Department of Agriculture Technical Bulletin No. 677, *Experiments in Breeding Holstein-Friesian Cattle for Milk and Butterfat Producing Ability, and an Analysis of the Foundation Cows and of the First Outbred Generation,* by M. H. Fohrman and R. R. Graves (April, 1939).

It may also be of interest to report that a list of sires proved in Dairy Herd Improvement Associations is compiled annually by the Bureau of Dairy Industry and published by the United States Department of Agriculture.

LIVESTOCK IMPROVEMENT DEMONSTRATIONS

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THE first of a series of livestock demonstrations of the kind now fairly widely adopted up and down the country was held at the Northamptonshire Institute of Agriculture in June, 1943, on behalf of the County War Agricultural Executive Committee. The main object of the demonstrations has been to show, as far as possible by practical example, just how livestock improvement may be brought about.

These notes are based on those demonstrations promoted by War Agricultural Executive Committees, at which the writer has acted as demonstrator. They have been of two types. Collective demonstrations of a comprehensive nature covering both dairy and beef cattle, and in certain cases sheep and pigs, have been held either on a selected farm or in a market, and the animals used have been borrowed from a number of owners. Smaller demonstrations have been conducted on individual farms, the stock in this case—usually dairy cattle—being drawn from the

herd on the farm concerned. In all instances the demonstrations have followed the same general lines. The animals have been passed through a ring, either singly or in groups, and a running commentary given through the microphone. On farms, seating accommodation around the ring has usually been arranged by placing baled straw in tiers under cover of a Dutch barn. It was in this way that some 1,000 people were seated at the demonstration held at Madresfield, Worcester, in May last.

Improvement for Milk The annual average yield of the dairy cows in this country is stated to be under 500 gallons, while the average in the best herds is 1,000 gallons or more. The demonstrations have sought to show how the level in the lower herds may be raised—by using good dairy-bred Shorthorn bulls in herds which at the outset are predominantly Shorthorn, or, alternatively, by grading from a mixed or non-pedigree foundation by a succession of British Friesian or Ayrshire bulls, so that after four generations the cattle become fifteen-sixteenths pure Friesian or fifteen-sixteenths pure Ayrshire, as the case may be.

It is recognized that improvement has been secured most effectively by the full use of sires which have proved to be specially good getters, but all bulls must start their active life as yearlings, and most farmers have to be content to buy at this age. Therefore, the demonstrations have set out primarily to illustrate the value of a progeny-tested sire and to indicate the qualifications that should be sought in an untried youngster.

A typical example of a progeny-tested sire was available in the demonstration held on Messrs. G. and G. J. Wooster's farm in Leicestershire. This bull, "Stowe Foggman 3rd," is now 13 years old, and eight of his daughters were shown in the ring. Three of them were born in 1934, and the mature cows had given lactation yields of 1,048 to 1,270 gallons—figures which represent a satisfactory increase compared with those of their dams. Moreover, the ten-year-old cows looked remarkably youthful, indicating that they have the sort of constitution to stand up to high production over a period of years. The inclusion of a yearling bull by the same sire as these cows gave the opportunity to make the point that it is a useful qualification in a young bull if, amongst other things, his sisters and half-sisters have proved to be heavy milkers.

When buying a young bull, however, it is often difficult for the purchaser to obtain full information about the performance of his immediate female ancestors. In this connexion it is the performances of the dam, two grand-dams, and four great grand-dams which matter most, but unfortunately few sale catalogues give this information. Invariably, a bull is included in the demonstrations, whose pedigree and milk records are given in the extended form—the form that provides the information which an intending purchaser ought to have. For example, in the Moulton demonstration in June, 1943, the pedigree of the Ayrshire stock bull was printed as shown below, and as the bull was paraded in the ring, attention was drawn to the more valuable features in his pedigree—namely, the consistent yields with high butter-fat, the fact that the dam was a 6,000-gallon cow at 4 per cent. and so on. In this way an attempt is made to drive home the point that in a dairy bull it is the performance of the near relations—sisters and immediate female ancestors—which matters until the evidence of daughters' yields becomes available as well.

LYONSTON FOUNDATION, 42181

Born April 3, 1938

SIRE :

Lyonston Kodak, 37908

- **Lyonston Challenge, 32473**
  - **South Craig True Line, 30011**
  - **Lyonston Miss Craig 7th, 20438**
    - 1201 gal. at 4·47% in 59 weeks as heifer
    - 1248 gal. at 4·32% in 50 weeks
    - 1382 gal. at 4·34% in 43 weeks
    - 1199 gal. at 4·30% in 48 weeks
    - 1675 gal. at 4·16% in 44 weeks
    - 1506 gal. at 3·90% in 47 weeks
- **Lyonston Katherine 5th, 31218**
  - 1425 gal. at 4·44% in 53 weeks as heifer
  - 1092 gal. at 4·57% in 47 weeks
  - 1125 gal. at 4·21% in 44 weeks
  - 1060 gal. at 4·08% in 35 weeks
  - **Lyonston Broon Bun, 28367**
  - **Lyonston Katherine 2nd, 10097**
    - 1349 gal. at 4·02% in 52 weeks
    - 1166 gal. at 3·99% in 45 weeks
    - 1206 gal. at 4·35% in 41 weeks
    - 1630 gal. at 3·81% in 50 weeks

DAM :

Lyonston Lady Flora 2nd, 26709

958 gal. at 4·38% in 49 weeks as heifer
1025 gal. at 4·01% in 45 weeks
1100 gal. at 4·36% in 43 weeks
1082 gal. at 4·12% in 49 weeks
1119 gal. at 3·85% in 44 weeks
1054 gal. at 3·92% in 46 weeks

- **Lyonston Douglas, 25768**
  - **Lessnessock Replica, 22955**
  - **Harleyholm Lockerbie 4th, 31504**
    - 933 gal. at 4·06% in 48 weeks as heifer
    - 914 gal. at 4·25% in 44 weeks
    - 1030 gal. at 3·98% in 32 weeks
    - 1232 gal. at 4·03% in 48 weeks
- **Auchenbrain Lady Flora 12th, 92378**
  - 1018 gal. at 3·74% in 41 weeks
  - 1110 gal. at 3·70% in 43 weeks
  - **South Craig Footprint**
  - **Auchenbrain Lady Flora 8th, 57298**
    - 809 gal. at 4·20% in 48 weeks as heifer

But records alone are not enough: it is important that the bull's dam should have a well-shaped, wide udder, coming well forward and well up behind, with four correctly spaced teats of suitable size, a strong loin, a shapely, good-wearing sort of hind leg, a deep body with plenty of capacity, the usual signs of good health, and ability to stand up to heavy production. It has usually been possible to find a cow to exhibit along

with her son to illustrate these points. There was a notable example in the Soke of Peterborough demonstration in Mr. C. Plant's Friesian cow, "Yoyo 2nd," that had given yields of 1,509, 2,262, 1,839 and 1,779 gallons, and was paraded along with her yearling son, got by "Terling Criterion," a sire well bred for milk. Here we have a rather striking example of high milk-yield pedigree, but, in addition, both the bull and his dam were animals of individual merit of much scale and substance and on short legs. There have been many other good bulls included in the demonstrations, which have shown what dairy farmers should try to get when buying a stock bull. It is true that the question of price may be a limiting factor, but that applies less in the dairy than in the dual-purpose breeds. Moreover, several War Agricultural Executive Committees are rearing selected bull calves for sale to farmers, and specially useful lots of these were paraded in the demonstrations at Rugby and Gloucester.

Grading-up Meanwhile the least costly way of establishing a pedigree herd is by starting with non-pedigree females and making use of the official grading-up schemes which are promoted by those breed societies that have open herdbooks; moreover, this is the only way of increasing substantially our numbers of pedigree cattle. Among the best practical examples of grading-up so far seen was that of Mr. A. Ludlow Hewitt's cattle, which were included in the Worcestershire and Gloucestershire demonstrations. Mr. Ludlow Hewitt started his herd 25 years ago by the purchase of ordinary non-pedigree cows, mostly Shorthorns, in Gloucester market. In 1923-24 his herd average was 746 gallons for 34 cows. Ever since he started, he has used a succession of pedigree Friesian bulls, carefully selected on milk records, and the herd now consists of black and white cattle entered in the Supplementary Register of the British Friesian Society. Last year the herd average was 1,021 gallons for 66 cows and first-calf heifers, and no fewer than 37 gave over 1,000 gallons. The present principal stock bull, "Farley Gold Digger," is becoming a sire of proven merit. He is by "Farley (Imp. 1936) Roland," and is thus half-brother to a number of high-yielding cows.

Here is the sort of thing which, it was demonstrated, has happened in this herd. A red Shorthorn cow was mated to a Friesian bull and produced a first cross named "Phyllis 1st," which gave 880 gallons as a heifer and 5,600 gallons in six lactations. Her daughter, "Phyllis 2nd A.S.R.," gave 817 gallons as a heifer and 6,228 gallons in seven lactations. The grand-daughter, "Phyllis 4th B.S.R.," gave 877 gallons as a heifer and, up to date, 4,618 gallons in five lactations. The great grand-daughter, "Phyllis 7th C.S.R.," by "Farley Gold Digger," gave 1,134 gallons as a heifer and 1,265 gallons in her second-lactation. Moreover, "Phyllis 7th" is a really grand cow of beautiful quality, with an exceptionally well-shaped udder and good hind quarters. She illustrated in a really striking manner what can be done by pursuing a consistent breeding policy over a period of years, and she provided a definite source of inspiration and encouragement, particularly to the younger generation of commercial dairy farmers.

Another notable example of successful grading-up was demonstrated in the Kynnersley Herd in Shropshire. This herd was founded in 1921, and has been graded-up from a foundation stock of ordinary commercial cows by the use of a succession of carefully selected pedigree British Friesian bulls. By 1930 the average yield had passed 1,000 gallons, and in 1943 was 1,051 gallons for 50 cows and 1,034 for 8 first-calf heifers. One of the bulls used, "Glentanar Barjouk P.I.," has proved to be a notable stock getter. Several of his daughters were on view and the following striking details of his

daughters' yields compared with their respective dams' yields at the same age, namely as first-calf heifers, were printed in the catalogue of this demonstration.

Dams				Daughters			
Name		Yield (*gal.*)	Lactation (*days*)	Name		Yield (*gal.*)	Lactation (*days*)
Black Leg	N.P.	842	328	K. Bellinda	ASR	1058	341
K. Snowdrop	ASR	976	313	K. Snowflake	ASR	801	247
K. Bluebell	ASR	669	273	K. Birdie	BSR	870	321
K Dill	ASR	562	288	K. Dilly	BSR	933	365
K. Dean	ASR	779	324	K. Jessie	BSR	728	325
K. Tess	ASR	1297	403	K. Tabatha	BSR	1063	365
K Fify	ASR	1126	339	K. Fairy	BSR	1117	389
K Polly 2nd	BSR	1075	331	K. Prudence	CSR	1038	351
K. Wyn 2nd	BSR	650	234	K. Winifred	CSR	1396	376
K. Dill 2nd	BSR	930	429	K. Dilly 4th	CSR	798	278
K. Dot	BSR	814	367	K. Dot 2nd	CSR	980	388
K. Fancy 2nd	BSR	910	338	K. Fancy 3rd	CSR	1032	364
K. Gay Girl	BSR	1220	365	K. Gussie	CSR	1347	346
K Hetty 2nd	BSR	952	332	K. Hermione	CSR	1020	366
K Judy	BSR	988	358	K. Judy 2nd	CSR	754	279
K Olwyn	BSR	1091	363	K. Olwyn 2nd	CSR	1543	442
K. Sybil	BSR	789	310	K. Sue	CSR	1193	352
K. Beauty 2nd	CSR	773	357	K. Bisto	DSR	1393	374
K. Jane 2nd	CSR	1061	321	K. Jane 3rd	DSR	831	309
K Gert	CSR	1067	365	K. Gert 2nd	DSR	729	381
K. Peggy 3rd	CSR	999	350	K. Peg	DSR	771	280
K. Peggy 4th	CSR	958	299	K. Peggy 5th	DSR	866	255
Average ..		933	336	Average ..		1012	340

There was a specially interesting case of improvement for milk yield in the Durham War Agricultural Executive Committee's demonstration at Darlington. For more than a generation the Gainford Hall herd of Shorthorns had been one of the most celebrated beef herds in Britain. Some thirteen years ago, however, the owners, Messrs. J. & R. Harrison, decided to go in for milk selling, and milk recording was started. At the outset the yields were not high, but by careful selection, and by the use of bulls with milk behind them, the average production has been steadily raised The herd now contains some magnificent dual-purpose type of cows, with great frames, a wealth of level flesh, deep ribs and remarkably wide, well-attached udders. A typical representative included in the demonstration had given 1,005 gallons with her first calf.

Mr. John Harrison stresses the point that in rearing their heifers for the dairy herd, it is essential not to overdo them. As yearlings, and until a couple of months before calving, the Gainford heifers are grazed on an upland farm in the Fell district. They are wintered in yards, mainly on turnips and straw, and at no stage allowed to become overfat. If grazed as youngsters on the rich pastures in the Tees valley, the heifers develop much flesh and too much fat, and later prove to be indifferent milkers.

Longevity It is a criticism of British dairy herds that the cows last only for a short working life, variously stated as being on the average from 2 years 6 months to 3 years 4 months. It is possible that the methods of calf-rearing in the last thirty years may have had something to do with this, but partly it may be due to confusing beefiness with strong constitution. The test of real constitution is a long working life, and it may be argued with some reason that the animal which can continue

to give heavy yields over a long period of years is likely to have the sort of conformation that is linked with constitution.

Three especially notable examples have been shown in the demonstrations. One is the pedigree Ayrshire cow, "Rockhall Mains Violet 2nd," born in December, 1926, and shown at Gloucester. She is still milking and in calf, and in her last nine lactations has given 10,189 gallons, including 1,253 gallons in 1942–43. Another is the black and white cow, "Beauty A.S.R.," which was shown at Rugby. She was born in 1928 and spent several years in a Liverpool town dairy. When 12 years old she gave 2,458 gallons in 365 days and has averaged 1,347 gallons in her last three lactations. A third is the Berkshire Demonstration Dairy Shorthorn cow, "Primrose 4th," Class C, D.S.A. register, which in thirteen lactations has given over 50 tons of milk. All three cows are of the same type—short on the leg, with plenty of room for the vital organs, exceptional depth of rib, strong loins and hind legs, wide hind quarters, and well-attached udders. Judging by the three animals' appearance and performance, these points would seem to be much more important as indications of constitution than mere beefiness, which often means no more than that the cow is putting her food on her back in the form of meat instead of into the bucket in the form of milk.

Controlling Old Bulls The importance has been stressed of using a proven bull as long as he will breed. But old bulls are often rather difficult to handle, and it is desirable that they should be controlled. Both at Moulton and on Mr. C. E. Harvey's farm, it has been demonstrated that an old bull can be controlled effectively by keeping him on a movable chain attached to a stout cable running from the inside of his loose box to the outer side of his open yard. The chain is passed through the bull's ring to a leather strap fixed below his horns. No difficulty has arisen in getting the bull to serve cows without releasing him from his chain and cable. The cows are simply led or driven into the yard and taken away again after service*. At Moulton, the length of the cable is 20 ft. and the length of the chain from the bull's ring to the cable is 7 ft.

Improvement for Beef On farms unsuitable for milk production and where rearing for beef continues to be practised, the Ministry of Agriculture recommends that greater attention should be paid to the use of suitable pure-bred beef bulls, preferably bulls of breeds, such as the Hereford and Aberdeen-Angus, which colour-mark their calves. Cross-bred calves with the typical colour markings inherited from a Hereford or Aberdeen-Angus sire can readily be recognized in the market or elsewhere as of beef breeding. In the demonstrations, Hereford and Aberdeen-Angus bulls of good crossing type have been shown along with typically marked cross-bred calves, got by bulls of these breeds. The need for and value of size and substance in bulls for crossing has been specially emphasized.

On cheap land it may be economically sound to run hardy sort of cows, which rear just their own calves in a season ; but on lowland mixed farms it is necessary to rear three, four, five or more calves on a cow, if the business is to be profitable. These points have been brought out, and attention drawn to the need for supplementary feeding—particularly before and immediately after weaning, when several calves are being reared at one time†.

* See article, *How to Keep a Bull until Proven*, by C. W. Brighten., p. 301.
† See article, *Calf-rearing in Cardiganshire*, by R. L. Jones, p. 304.

At the Brampton Ash, Northants, demonstration held in December, 1943, a pair of Aberdeen-Angus heifers, the property of this Institute, were shown to illustrate the point that early maturity depends on "feed" as well as "breed". One heifer had been reared on a high plane of nutrition, with the result that she had developed bone, muscle (flesh) and fat simultaneously, and reached a heavy weight for age. The other had been reared on a moderate plane of nutrition, and, by comparison, she had not reached as advanced a standard of early maturity—in other words, she had developed bone and muscle (flesh) but the plane of feeding was not high enough to enable her to develop fat at the same time.

In the Rugby demonstration there was an interesting exhibit consisting of a pair of useful, two-year-old Dairy Shorthorn steers, each out of a 1,000-gallon cow and got by a bull well bred for milk. The steers were of quite good beef type and demonstrated the dual-purpose qualities which are claimed for the breed. The same sort of exhibit could well be provided with Red Polls on farms or in districts where the Red Poll is commonly kept.

The Commercial Aspect The value of livestock demonstrations as a whole depends primarily upon the selection of animals of essentially *commercial* merit—animals which really illustrate the story to be put over. In certain instances there has been some tendency to include animals simply because they were of good show type, but however impressive they may be, unless they actually fit into the pattern of the livestock improvement plan, these animals tend rather to confuse the issue. It should be kept clearly in mind that it is the *commercial* aspect of the matter which is of greatest importance to ordinary farmers.

HOW TO KEEP A BULL UNTIL PROVEN

Claude W. Brighten, O.B.E., F.S.I., F.L.A.S.

Maidenhead

THE proven bull is frequently put forward as the solution to the problem of upgrading commercial dairy herds, but the problem is how to prevent a good bull from being slaughtered before he can become proven. Bulls of all breeds from three years old upwards tend to become uncertain for handling and to develop vicious ways which lead many herdsmen to put their own safety before the prolongation of the life of the bull—and one cannot blame them. It is therefore for the employer to adopt means to ensure the safety of his employees ; in fact, many individual herd owners have already done so. By means of the Hale overhead cable system, plus the service box at the end of the cable and in the outer run, fractious bulls can be controlled effectively and so preserved until proven.

In the Yewden Dairy Shorthorn Herd it recently became imperative to control "Wicklesham Musician," an 8-year-old bull. He was far too precious to be slaughtered, being out of a dam that had given over 100,000 lb. with her first five calves. Thus, after inspecting the bull pen of an Ayrshire breeder and also one at the Reading University Farm (to both of whom it is desired to give grateful acknowledgment), it was decided to erect a Hale overhead cable and service pen.

Description of Overhead Cable and Service Box In the inner box the cable is run over the manger at a height of 5 ft. from the ground. This allows the bull chained to the cable to lie down in comfort. It is desirable to provide a feeding hatch in the wall over the manger, making it possible for the bull to be fed safely; it is useful too for the purpose of catching the bull and securing him for grooming or when cleaning out the pen.

The end of the cable is made secure to the far corner of the service pen at a height of 8½ ft. above ground.

The service box has proved a great success, and seldom has the introduction of the female into the box and subsequent service taken longer than five minutes, so effecting a considerable saving of time and labour. One man—the herdsman—can easily control proceedings. A word of warning should, however, be given: the herdsman should be quite certain that the female is fully in season before placing her with the bull, since she has no possibility of escape and damage to the cow may result from incautious use of the pen.

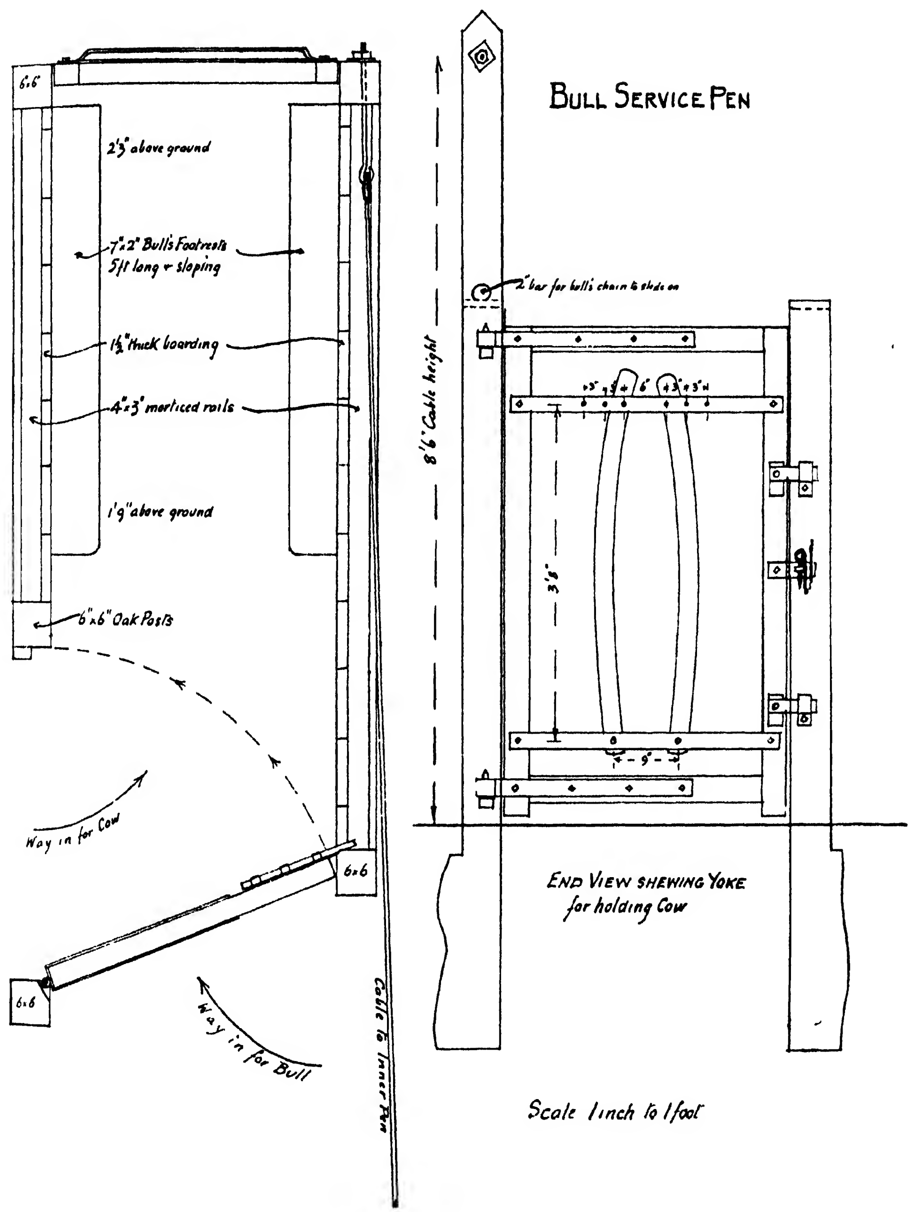
The plan opposite shows more clearly than words the lay-out of the service box. The inside of this box should be as smooth as possible, and close, vertical country-cut boarding should be used: horizontal rails present too many risks with a valuable animal. The provision of a yoke in the head door, to hold the female firmly and to give her support when the bull imposes his weight, is sound; this was adopted from the Reading University design.

Costs As regards cost, the work was, in the instance referred to by the writer, done by the Estate Repair Staff with estate-produced timber, but there is no reason to suppose that the cost would be higher if carried out by any country builder.

The details of our costs are as follows:

40-ft. cable; 1 screw-hook to pierce 9-in. wall and another to connect to 6 in. × 6 in. post; 1 complete set of harness with lead and chain to cable ..	£5	5	11
Estate Labour	£9	11	6
Estate Materials	£10	7	6
TOTAL COST	£25	4	11

Breeders, generally, wish to support the declared policy of improving British live stock, and the extended use of older bulls can play a great part in developing this policy.



Claude W. Brighten.

CALF-REARING IN CARDIGANSHIRE

R. L. JONES, F.S.I.

Cardiganshire War Agricultural Executive Committee

UNTIL about 1932 the county of Cardigan was noted for its store cattle, which were offered for sale at its marts and fairs every autumn and spring. Practically every farmer, apart from a few milk producer-retailers adjoining the urban areas, reared all their calves, and occasionally an additional calf was purchased. I well remember the days when the farmer, to increase his bunch of steers 18 months or 2 years later, would pay more for a good male calf than he would for a heifer.

The Old Method Most Cardiganshire farms are small, and the average number of cows did not exceed 6 to 8; and these usually calved between February and April. The cows were sold when bringing their third or fourth calf, and one or two heifers were retained to replace them. The cows were hand-milked and the calves were pail-fed from the start; the milking, together with the feeding of the calves, was usually in the charge of the farmer's wife. The calf received about a gallon of fresh milk daily at the beginning, which was increased to two gallons by the time it was 5 to 6 weeks old. After this the level of milk fed remained the same until the calf reached the age of 14 to 16 weeks. Part of the fresh milk was replaced by skim milk after 7 or 8 weeks, and the portion of skim milk was increased daily, so that no fresh milk was given after the calf had reached the age of 10 weeks, or in some cases 12 weeks. During this latter period the calf received some crushed oats and sometimes a little home-made gruel, and with such a start in life the calf grew well and kept a good bloom.

It was customary for the farmer to allow his wife all the money she made from the sale of butter and eggs, he himself retaining the cash received from the sale of the store cattle to pay the rent and wages (if any). When in 1932 and 1933 the farmer received only about £7 apiece for his 18-months-old steers, and the farmer's wife received 7d. a lb. for her butter, the partnership was facing bankruptcy.

About this time a milk factory was established in one corner of the county, and the majority of the farmers in the surrounding area immediately changed over to milk selling. Although the net summer price of milk, after deducting transport charges, was as low as 5d. a gallon, they managed to avoid the disaster which faced them a few years earlier. By 1940 only about 25 per cent. of the farmers reared all their calves, and these were invariably the high land farmers inconveniently situated and with long, poor roads before they could reach the lorry routes.

Committee's Calf-rearing on Nurse Cows The County War Agricultural Executive Committee having taken possession of a number of farms on which the farm buildings, where still existent, were in a dilapidated state and totally unsuitable for milk production, decided to stock them with store cattle to consume the straw during the winter and to graze the young leys during the summer.

In 1942 suitable stores were becoming scarce, and early in 1943 the Committee decided to start rearing store cattle, since there was a fair selection of male calves available at two or three grading centres in the county. Freshly calved cows were purchased in the local markets, the cows selected being mainly third and fourth calvers of the dual-purpose

Shorthorn type not eagerly sought after by milk producers. Sixteen cows with calves were purchased in April, 1943, at an average cost of £32 10s. Additional male calves were purchased, as each cow was expected to suckle two calves until they were about 8 weeks old. After that a fresh pair of calves was put on each cow, and most of them managed even a third pair, the latter being suckled for 10 or 11 weeks. The cow finished off by rearing one calf and was then dried off to calve down again about the same time the following year. On one small farm five cows, purchased about the end of March, 1943, reared 37 calves by Christmas. Had it been possible to buy protein, such as linseed cake, bean meal or white-fish meal, in sufficient quantity, the suckling period could have been slightly reduced and consequently the number of calves reared increased.

Weaning When weaned, the calves were given a little gruel prepared from "Calf-follower Meal" as well as dry feeding, which had been introduced before weaning. The dry food consisted mainly of crushed oats, with a little linseed cake added when available. When the calves were 3 to 4 months old an allowance of kale, cabbage or pulped roots was given when available. On some of the farms it was found that the calves thrived well when they were given some unthreshed brown oats—Ceirch Llwyd or Ceirch-du-bach—in the racks; both these oats are grown successfully on the poorer land in the county.

All the calves were kept indoors during 1943, but they were turned out to graze the young leys early in April, 1944; by August they were in a good, forward condition, suitable for turning into the yards to consume the straw, etc. during next winter. In addition to these roughages, they will receive a small allowance of crushed oats, together with kale or roots grown on the Committee's land.

The system of suckling the calves was adopted because practically all the labour available to the Committee lacked previous experience of calf-rearing. Undoubtedly, if the cows were hand-milked and the calves fed off the pail, a few more calves could be reared, and these would escape the setback they suffered at weaning time. The cow herself would also be able to withstand the strain better, especially if she is a good milker. Naturally had the calves been under the personal supervision of an experienced farmer, considerably better results would have been obtained.

Livestock Demonstrations Stimulate Interest The Technical Development Committee has done much to encourage calf-rearing in the county, and at three large-scale livestock demonstrations held during May and June this year one of the cows referred to above, together with seven of the store cattle which she had reared in 1943, were shown. Great interest was evinced by farmers in this exhibit, and it appears that some of the non-milk producers may adjust their stock by reducing slightly the number of cows and increasing the number of calves reared. Also, some of the milk producers are likely to set aside a few nurse cows for successive suckling of calves as practised by this Committee, thus rearing their own dairy cow replacements and possibly a few steer calves.

A Calf-rearing Trial The Committee further demonstrated the amount of milk necessary to rear a calf as a store. Six male calves were purchased at a Grading Centre in March this year, and

were divided into three groups of two each :

GROUP A received one gallon per day for one month—total 28 gallons.

GROUP B received one gallon a day at the start, increasing gradually to 1½ gallons and weaned when 6 weeks old ; this pen received a total of 52 gallons per calf.

GROUP C received one gallon a day, gradually increasing to two gallons a day and weaned when 12 weeks old ; this pen received a total of 140 gallons per calf.

Although Group C is most forward at the present time, it is found, after making due allowance for the cost of the milk, that Group B is thriving well and will prove more economical for the farmer. Group A is rather backward and will need more attention during next winter if these animals are to equal those in Group B at 18 months old. These calves were also exhibited and created much interest at the livestock demonstrations.

It is noticeable at the grading centres that many farmers are buying calves for rearing, and it is probable that the number of young cattle in this county will increase if the price of store cattle is maintained.

No doubt the present is an opportune time to investigate and demonstrate the value of different foods for calf-rearing, particularly in regard to home-grown foods. Many farmers are anxious to learn about the subject, and it is suggested that it would be a good thing for Technical Development Committees in every county not only to hold demonstrations but also to conduct calf-rearing trials.

PROTEIN SELF-SUFFICIENCY ON THE FARM

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MOST of our home-grown crops when harvested at the conventional times show on analysis a relatively low proportion of protein or flesh-forming material to carbohydrates and oil—the energy-yielding and fat-forming constituents. Rations consisting solely of these feedingstuffs are, according to scientific standards, "unbalanced" for most classes of stock, but more especially for cows in full milk and young, quickly growing animals. This was rectified in pre-war years by the use of high-protein concentrates—which were plentiful and cheap. Nowadays, however, with the supply curtailed, there is real difficulty in balancing rations. If insufficient attention is paid to this aspect of feeding, waste of valuable materials is inevitable, owing to poor utilization of the nutrients by the animal. Not only high costs of production but also limited production of milk and meat are, in such circumstances, unavoidable. The problem then for the farmer who has to carry on with a minimum of purchased concentrates is to find some means of obtaining sufficient protein for economic rationing.

Protein in Beans The bean crop which contains about 25 per cent. protein (78 per cent. in a digestible form) at once suggests itself. Thus beans are sufficiently high in protein for admixture with low-protein cereals, like oats, to give a balanced concentrate. Four pounds of a mixture consisting of 4 parts oats to 3 parts beans supply 2½ lb.

of starch equivalent, including ½ lb. of protein equivalent—the accepted standard of balanced food constituents necessary for the production of one gallon of milk. It is unfortunate, however, that the bean crop is rather uncertain and, except on medium to heavy land which is well drained and in a good state of fertility, the yields are disappointing. It is obvious, therefore, that many farmers must look to other sources for the protein necessary to attain any real degree of self-sufficiency.

Protein in Grass Every farmer is fully aware of the valuable feeding qualities of grass, as grazed, for the production of both milk and meat; yet when it comes to preserving it for winter use, it would seem from current practice that its high protein content is almost entirely forgotten. At present the great bulk of grass not needed for grazing is made into hay at a stage of growth which precludes all possibility of getting a product rich in protein. It is true that there is a general trend throughout the country to earlier cutting, but this fails substantially to make use of the high protein content of grass. It is a well-established fact that as the growth of grass proceeds to full maturity, the percentage of protein drops continuously, owing to the manufacture by the plant of a much greater proportion of carbohydrate. This is most marked when the plant begins to flower, so that it is not surprising that so many hays are low in protein when it is remembered that they are derived from grasses and clovers which have reached, or in many cases gone well past, this stage of growth. Let us consider a few examples. Twenty-two samples which, with two exceptions, were classed as meadow hays and analysed by Watson and Ferguson (Jealott's Hill Research Station) gave an *average figure of* 8.9 *for the percentage of protein in the dry matter*, (i.e., 7.6 in a hay with the usual 15 per cent. moisture). The authors state that "these samples were collected from fifteen counties in Great Britain in 1935—a favourable year on the whole at the normal season for haymaking, and that the majority of the farmers from whom these were obtained described their hay as a good sample'." Recent analyses by the same authors and reported in this JOURNAL* show that 85 samples of first year seeds hay had an *average protein content of* 10.7 *per cent in the dry matter* (i.e., 9.1 per cent. in a hay with 15 per cent. moisture). Hays from second and third year leys showed lower figures. Analyses by the writer amply confirm these findings. It should be noted that the more clover there is in a hay the higher the protein.

More Protein by Cutting at Early Stage of Growth The dry matter of young grass, before the onset of flowering, contains a high percentage of protein—say, 15 to 20 per cent. or even higher—and it is only by cutting it at this stage that a worthwhile, proteinous product is obtainable. The younger it is cut the higher the percentage of protein. Harvesting this young grass as hay is out of the question, owing mainly to its naturally high water content and the consequent longer time required to dry it thoroughly in the field, together with the difficulty of handling such material. It can, however, be preserved successfully in the form of silage, and it is to be noted that with young herbage of this character, it is easier to make a complete success of ensilage than with older, more mature herbage; it packs more easily by reason of its sappiness and freedom from coarse, stemmy material. When ensiling a point to be remembered is to allow each successive filling to heat up to a temperature of at least 100°F., in order to avoid the development of a butyric type of fermentation, which results in an evil-smelling rancid

*W. S. FERGUSON AND S. J. WATSON: "Rotation or Seeds Hay". (1943) **50**, 110.

product. A silo well filled with young herbage (early spring or aftermath) has practically no waste or inedible material at the sides and top. Twenty pounds of such pleasant-smelling silage, containing 16.5 per cent. crude protein in its dry matter of 22.5 per cent. will supply the nutrients required to produce one gallon of milk.

Protein in Forage Crops The protein content of forage crops such as mixtures of oats, vetches, peas, etc., like that of grass, decreases with advancing maturity, so that the stage of growth at time of cutting is of paramount importance. Early cutting—the oats at the "shooting" stage, and the peas and vetches in flower—is therefore essential if the aim of protein self-sufficiency is to be attained. If, on the other hand, the aim is merely to make good a deficiency of hay, later cutting—oats at the "milky" stage and when the lower pods of the legumes are just forming—can be adopted.

Whatever the stage of growth at cutting, the harvesting of these crops frequently presents a problem, and the following remarks, based on the experience of the writer in the field and laboratory, may serve a useful purpose. Hay made from the later cuts of these crops is apt to turn mouldy in the stack through being carted too soon. The legume, if present in considerable quantity in the mixture, is difficult to dry out, and visual inspection is sometimes at fault. Such a hay will contain about 7 to 10 per cent. protein in the dry matter varying according to the proportion of legume present, and its feeding value will approximate to that of a seeds hay with a medium clover content.

A better plan for dealing with these semi-mature crops is to ensile them. A cutter-and-blower outfit is essential, however, if waste at the sides of the silo is to be avoided. It is practically impossible to get sufficient compaction in a silo filled with coarse material in an unchaffed condition. The silage from a mixture containing a moderate amount of legume will average from 10 to 12 per cent. protein in the dry matter and will contain a fair amount of carotene.

A high-protein product can be obtained from these crops only by cutting at the early stage of growth mentioned above, and, in general, ensilage is the only method available for their preservation. The chief difficulty here is the extraordinarily high water content of such immature crops. This may be as much as 87 per cent., even when no rain water is present; if ensilage is attempted in wet weather this disadvantage becomes still more acute. Experienced silage-makers will no doubt appreciate the difficulty referred to—namely, that of getting each day's filling to heat up sufficiently to avoid the butyric type of fermentation.* Thus with shallow layers and waiting periods during the filling of the silo, the whole process is apt to become tedious and prolonged. To obviate this the crop should be slightly wilted in the field—until the water content falls to about 75 per cent. (the optimum figure also for early cut grass). This has the added advantage of reducing the loss of valuable effluent from the silo. Wilting to the extent indicated will not seriously impair the carotene content.

Protein in Kale The kale crop is now becoming increasingly popular, particularly with the dairy farmer. It is a valuable source of protein, containing on the average about 15 per cent. in the dry matter, and therefore contributing a useful aid to protein self-sufficiency. It is worth noting here that a 25-ton crop of marrow-stem kale gives as much starch equivalent as a 30-ton crop of mangolds, but *more than twice*

* W. McLean: "Silage-making in North Wales". *Jour. Min. Agric.* (1943) ***50***, 74.

as much protein. Its lack of keeping quality in a hard winter and the labour problem involved in cutting and carting in all weathers are not in its favour, but these difficulties can be largely surmounted. Experiments in Yorkshire and other counties have demonstrated that chaffed kale can be ensiled successfully, and it is recommended that the process should be carried out during October to December, when the crop is at its best. The extension of kale ensilage, which is likely to take place in the coming months, will, it is hoped, bring this crop into still greater prominence as a source of protein.

To Sum Up A suitable combination of the various methods mentioned in this article for increasing a farm's protein will give not only greater latitude in the balancing of rations, but also the possibility of a change of rations during the winter months—and this is highly desirable for maximum milk production. Further, with such a supply of succulent high-protein feedingstuffs, much more oat or barley straw could be incorporated in rations than is possible at present. In addition, a supply of carotene is assured during those winter months when little or no green foods are available. It will be remembered that carotene—the precursor of Vitamin A—is the yellow pigment which gives milk its rich yellowish colour when cows are on grass and is a factor of great importance to the health of all milk consumers.

WINTER RATIONING ARRANGEMENTS FOR LIVE STOCK, 1944-45

There will be few changes in the rationing arrangements for the coming winter, as compared with last winter.

DAIRY HERDS

Rations during the winter months (October to April inclusive) will again be based on milk sales two months previously. The monthly allowance will be 1 unit of protein and 2 units of cereal for each 80 gallons of milk sold in excess of 15 gallons per cow per month, subject to a deduction of 48 lb. of cereals per cow per month (equal to 3 cwt. per cow during the seven winter months). This means that the farmer is expected to provide, in addition to maintenance, protein for the first ½ gallon, and cereals, i.e., feeding grains or their cereal equivalent in other fodder crops, for approximately the first gallon per day.

Supplementary Dairy Rations Agricultural Executive Committees have authority to waive wholly or in part the monthly cereal deduction of 48 lb. per cow, if because wheat or other essential crops are grown, or for other valid reasons, a farmer is unable to make the full provision expected of him; but only in very exceptional circumstances will rations be allowed towards the first ½ gallon.

Winter Milk Producers Rations for any two consecutive months from October to February inclusive may be allowed on estimated sales in the two selected months, if rations based on sales

two months previously would be inadequate because of the large proportion of cows calving in the meantime. In applying to exercise this option, the farmer should estimate his sales carefully, because rations for later months will be adjusted when the figures of actual sales are available.

Threshing The cereal deduction of 48 lb. per cow per month may be postponed if the farmer is temporarily short of fodder because he has been unable to thresh his oats or dredge corn. In these cases an extra deduction will be made from subsequent rations when threshing has taken place, or if threshing is so delayed that the extra deduction cannot be made, the sale of an equivalent quantity of grain will be required.

Compounds A farmer wishing to purchase compounds must surrender coupons in the proportion of 1 protein to 2 cereals ; coupons issued against milk sales are not, however, in this proportion because of the monthly deduction of 48 lb. of cereal per cow. The deduction will, however, be cancelled throughout the winter months if the farmer sells 3 cwt. of oats or dredge corn for each cow (including dry cows) in his herd, and produces a Certificate of Delivery on Form HGC/R.10 from the approved buyer. If a farmer wishes to purchase compounds but is unable to sell corn through delay in threshing, the cereal deduction may be postponed, as explained above, and will be cancelled when a certificate of sale and delivery of the requisite quantity of corn is produced.

Milk not Sold Whole milk supplied for human consumption without payment, for example, to farm servants or tenants, and milk consumed in the producer's household, may be regarded for rationing purposes as having been sold, if satisfactory evidence is produced regarding quantities, and the latter are not regarded as excessive. One-quarter unit protein per month may be allowed to anyone keeping not more than two cows who obtains no other rations for his cows.

Calf-rearers When dairy rations are calculated 25 gallons will be added to the gallonage of milk sold (or supplied without payment) for each calf under one month old that is being reared for milk or beef.

CALVES

Under 6 months old One-half unit calf food per month will be allowed for each calf up to the age of six months being reared for milk or beef, but the allowance will not normally be made where the owner is not selling milk.

Bull Calves in Milk-recorded Herds Farmers who are rearing bull calves from officially milk-recorded or pedigree herds may obtain protein and cereal coupons in the proportion of 1 protein to 2 cereals, at the rate of 1 unit per month, instead of the above allowance of calf food.

Heifer Calves 6-12 months old Rations at the rate of ½ unit protein and up to a maximum of ½ unit cereal, according to need, may be allowed for heifer calves 6–12 months old which are being reared either on hill farms where rearing is the chief occupation or on small-holdings where no milk is sold and calf-rearing can be successfully carried on.

WINTER RATIONING ARRANGEMENTS FOR LIVE STOCK

PREMIUM BULLS

A monthly allowance at the rate of ½ protein and up to a maximum of 1 unit cereal, according to need, may be obtained on application for premium bulls being used for service.

GOATS

Rations will be allowed at the rate of 1 unit protein and 2 units cereal for each 80 gallons of milk sold two months earlier, subject to a deduction of ¼ unit cereal per milch goat per month, where this can be provided by the owner.

Female Kids One-quarter unit calf food per month for kids under 6 months old, provided that the kid is likely to make a good milch goat.

Male Goats One-quarter unit of protein per month for male goats over 6 months old being bred or used for service, if registered with The British Goat Society.

Other Rations for Goats An allowance may be obtained for milch goats, goatlings up to 24 months old, or female kids over six months old being reared for milk, at the rate of ¼ unit per head per month, up to a maximum of 1 unit per month to any goat owner.

PIGS AND POULTRY

Basic rations (from September to April inclusive) are unchanged as compared with last winter, and will be granted for one-eighth of the numbers of pigs and poultry kept in June, 1939, or in December, 1940 (whichever date has already been taken as the basic figure), subject to the same deduction as that made last winter in respect of the acreage of the holding. The protein/cereal ratio will be 1 : 7.

Pedigree Pigs One-half unit per month on application for each pig registered with a Breed Society, up to a maximum of one-third of the number of pigs kept on the holding in June, 1939.

Premium Boars Owners of premium boars being used for service will be allowed, on application, a monthly ration of ½ unit of protein.

Farrowing Sows Six units for each sow or gilt about to farrow, provided that the owner undertakes to keep the animal until after farrowing, and to rear the young pigs until they are in saleable condition. This allowance is not available to domestic pig-keepers.

Sound Poultry Breeding Stocks Supplementary allowance will be at the rate of 1 unit per month for 18 fowls, 15 ducks or 9 turkeys. The ration so calculated will be increased by one-eighth in lieu of the special grain supplement, which is discontinued temporarily owing to inadequacy of suitable supplies.

Chick-rearing Rations Chick food coupons amounting to ½ unit for every 10 birds kept on June 3, 1944 will be issued where not less than 26 birds were being kept on that date. Issues will not normally be made to domestic poultry-keepers, poultry-keepers holding a "Small Poultry-Keepers' Ration Card," or to hatcheries rationed on the basis of pre-war purchases. Chick food coupons will be issued in November, and will be valid for January to April, 1945, but any poultry-keeper who is eligible may apply before the end of October, 1944, for autumn coupons in lieu of spring coupons. In such cases the coupons due for January to April, 1945 will be reduced accordingly.

HORSES

Working horses should be regarded as a first charge on the resources of the farm, and rations will be allowed only where insufficient home-grown oats are available. Allowances granted will vary according to the type of horse and the nature of its work. If bran is wanted, cereal coupons received for other stock (unless required for the purchase of dairy compounds) should be used to obtain supplies, and such other stock fed on oats grown for the horses. If the horse owner has no cereal coupons he will be allowed coupons for a small quantity of bran on selling a corresponding quantity of oats.

OTHER CLASSES OF STOCK

Issues may be made at the discretion of War Agricultural Executive Committees from reserves of protein and cereals at their disposal to special classes of stock in case of need. Applications for protein will be considered in the case of in-calf heifers and breeding stock generally, and also for dry cows where these comprise in any month over 20 per cent. of the herd. Cereal coupons are normally issued only to farmers who have grown essential crops at the expense of their fodder crops, and are, in consequence, short of feedingstuffs for their live stock.

SEED OATS AND BEANS

A grower of oats or beans may be allowed coupons if he satisfies his Committee that he has not sufficient food for his live stock because of his sales of these crops for seed purposes. A certificate from the buyer that the seed crops have been delivered after July 31, 1944 should be sent with the application, which must be received before May 31, 1945.

FEEDING PEAS

A grower of feeding peas (as defined in the Threshed Peas (Control and Maximum Prices) (Great Britain) Order, 1943, who sells and delivers peas from his 1944 crop between August 1, 1944, and June 30, 1945 may obtain protein coupons equal (to the nearest ½ unit) to half the quantity of peas sold. Application must be made to Committees within one month of the sale accompanied by the buyer's certificate that the peas have been delivered. These arrangements do not apply to peas of the varieties normally grown for human consumption.

FARMING ORGANIZATION ON THE COTSWOLDS

P. Webster Cory

Bourton-on-the-Water, Glos.

My justification for writing this article is the fact that I have farmed up in this district for nearly thirty years, on an acreage varying from 340 to 1,000. At the present time the acreage of this holding is approximately 850. Having passed through years of many changes, from the old-world farming to the new, mechanized age, the results of my experience may be of some interest, and perhaps benefit, to younger men. In the early days I made many mistakes, for which I had to pay in feeling my way towards a system of farming that ultimately proved successful—namely, what I call the Unit System, embodying a considerable turnover of stock and products. I suppose, even then, I realized that those basic principles of industry—organization, standardization and, in a certain sense, specialization—were necessary to get the best results and to deal efficiently with a considerable turnover, and I have since proved that these principles can be introduced even into the farming business.

I will pass over the years of hit and miss, mistakes and losses, as I think it is more useful to consider the years of success and profit and how that happier state of things came about.

A Pre-war Unit System Though to-day I have come to the conclusion that the alternate system of husbandry—involving a three- to five-years ley (in some cases longer)—is the right thing from the point of view of the land and of the stock, in the years before the war I had gradually laid down the whole of my arable land to indefinitely long leys. Thus, in considering my pre-war system, I want you to visualize 800 acres of grass, mainly in long leys, with some old pastures; practically every field adequately fenced (chiefly walls), and watered. The size of these fields varied from approximately 10 to 40 acres. The farm lies on the top of the Cotswold Hills—some 600–700 ft. up. The soil is of a loamy nature, retentive of moisture, and lies for the most part on limestone, with a ploughing depth of about four inches.

This Unit System means one man, or in the case of the dairy, two men, in charge of a unit of stock, directly responsible to me. All units of stock, with the exception of pigs and calves, worked on the movable system. On the dairy side there were two Hosier-type dairy units with a complement of some 70 cows each, including dry cows. We carried approximately 350 breeding ewes (grass sheep), which means some 800 to 900 head of sheep during the summer, or about six bunches of ewes and lambs. For poultry we had two large brooder houses with a capacity of about 2,000 each, and we kept a rearing unit of 80 or 90 folding pens, and 6 laying units, each with a capacity of 1,800 birds—that is, 74 folding pens. There was also a small, varying number of breeding sows and gilts.

Labour Before the war there were 18 men and one woman (part-time) on this holding. Of these, eight men were engaged with poultry, four men with the dairies, one shepherd (part-time on other work), one man calf feeding, pig weaning, etc., three service men—i.e., one head mechanic and two men for tractor driving, lorry driving, food mixing, carpentry, etc.—one relief man, enabling most of the stockmen to have one clear day off a fortnight, and one woman egg packer. Thus a high percentage of the labour was directly productive, and all were engaged almost entirely on essential work, which is one of the secrets of the proper utilization of labour.

Fertility as a By-product Movement of stock from day to day I arranged personally, with a view to keeping my material of manufacture—grass—in its highest productive state. Dairies could be moved on to practically any part of the farm to cash this material for dispatch in the form of milk. The herd wintered on the poorer land, of which there is a fair proportion in this hill country, and during the winter, being fed with hay and concentrates, they gradually improved the fertility of these poorer pastures. This improvement resulted purely as a by-product from what was during the process a paying proposition. The dairies also cashed the excellent grass produced and left behind by the poultry—likewise the sheep, in the form of fat lambs. In the light of the above it is interesting to note that two good fields which came under the plough during the war and were planted to winter wheat produced 14 sacks to the acre. This, of course, was exceptional, but the yields of many of these fields which had previously been well-stocked were very good.

The average annual output during the four years immediately prior to the war was as follows:

Milk	50,000 *gal.*
Calves	100
Lambs	460
Eggs	1,340,000
Hens and cockerels	6,700
Pigs	180

Production of these commodities affords the possibility of a much bigger turnover and a much more regular income than is possible with corn-growing; also it provides an opportunity of employing a much larger number of men on the land, as against the mechanization of arable areas. It also allows, under the alternate husbandry system, a great opportunity for keeping up the fertility of the land with organic manure, which again means that when it is broken up we can, other things being equal, get somewhere near the maximum yield of corn. Personally, I think that one way, if not the most economic, of maintaining fertility is by means of the long ley adequately stocked, and I think we have got to place great stress upon economic production.

Organization and Economic Production Now economic production means efficient management (and I would emphasize the word "efficient"); efficient management, in turn, means concentration upon detail, and, of course, connotes good equipment. Efficient management entails the building up of a well-organized outfit, capable of dealing with a large and probably increasing turnover, but it also means standardizing equipment where this is practicable, and turning out a uniformly sound article in public demand. Let us take one simple example of organization: How would you organize a large poultry outfit dealing with 5,000 to 10,000 birds, from brooder house to laying unit, between October and June? My methods have been as follows:

A statement showing the number of chickens, etc. goes into the Brooder House as each batch arrives. In it are recorded all details of the birds, including losses, etc. A duplicate book suitably set out shows outgoings from Brooder House to Rearing Unit, with details of the batches and a record of the numbers of the houses in which they are distributed. This is kept at the Unit. A similar duplicate book shows the weekly state of the Rearing Unit, and another shows outgoing birds to the different Laying Units, with numbers of houses to which they are allotted. Each Laying

Unit has its duplicate book suitably set out and showing the different classes of birds, losses, etc. The duplicate sheets come in to me at the end of each week.

Each Laying Unit also has its weekly ration sheet in the stores from which the food is drawn; also its egg sheet, showing the different age groups of birds and the number of eggs from each folding pen. At the end of each week a small balance sheet for each Unit is made out as follows, indicating how things are going:

1938	P.U. 5		£ s. d.	£ s. d.	£ s. d.
Aug. 6 to 12					
	Dec., 1937	3,134			
	Jan., 1938	2,154			
	Feb., 1938	466			
		5,754=479 ½ doz. at 17.21d.			34 7 8
	Food:	18 Laying Mixture at 9/1 ..	8 3 6		
		9 Poultry Corn at 8/11 ..	4 0 3		
		1 Grit at 2/11	2 11		
				12 6 8	
	Labour		2 7 5		
	Washing and Packing		4 6		
				2 11 11	
	Depreciation of Houses		18 8		
	Depreciation of Birds		3 0 0		
	Rent		6 0		
				4 4 8	
				19 3 3	

Eggs ..	£34 7 8	Less ..	£19 3 3
		Credit Balance	£15 4 5
	£34 7 8		£34 7 8

The above gives some idea of how, by means of these weekly returns or records (a simple workable organization), an almost perfect, chain-like picture can be kept of the position and happenings of a large egg-producing poultry outfit.

This sort of organization can be carried on to a greater or less degree according to requirements in each stock department. You need, of course, intelligent men, and, I think, with an interest in their output and efficiency in addition to their regular wage. I personally secure this by giving each man a bonus book. These books come to me quarterly, and I am able to bonus on their individual output and efficiency. In this way a man can either draw from his bonus book or allow the cash to accumulate and invest it in National Savings or anything else he likes.

Standardization and Uniformity of Type The Rearing Unit and each of the six Laying Units has a poultry float and a light horse. These floats are standardized and capable of doing everything required by the unit from taking out food to bringing in up to 1,000 or 1,200 eggs in standard baskets. Wheels are more or less interchangeable, and the harness is interchangeable with breast collars.

Now a word about uniformity in type. Our laying pullets were sex-linked Rhode Island × Light Sussex, bought as day-olds from the best breeders. In the latter connexion it is interesting to note the result of 1s.

per cwt. more or less on the feeding of a single unit of the above size. This amounts to approximately £75 per annum. Also one shilling more or less in the production of a laying pullet at about 20 weeks amounts to approximately £90, and finally that one dozen flock egg average up or down at 1s. 5d. (average price per dozen) amounts to over £100. As regards meat production, we crossed the Irish Shorthorn with the Angus bull and turned out black-polled calves, sold either by private arrangement or in the market for the buyer to feed. Our lambs were of a type that were known to meet the demand for small or medium-sized joints.

Thus careful buying, controlled feeding and efficient management are of considerable importance.

An Efficient Food Store This takes me on to another point—namely, the value of a well-run food store. We used to turn out anything up to 7 or 8 tons of food a week, for the most part making our own mixtures. I have always felt that this section of the farm is a sort of safety valve, because labour can be utilized economically according to what has to be done by us or what we would have to pay somebody else to do. A mechanical mixer in the stores delivered the food from the top storey, where the raw material came in, to the lower storey, where it was bagged and placed under the different heads ready for the week's drawing on a ration basis by the different units or classes of stock.

Orderliness on the Farm Another point of interest that I have proved beyond doubt is that it is possible, even on a farm, to keep almost perfect tidiness and order in all buildings, whether it be stores, tractor house, trailer sheds, or any other place of the kind. Once the men realize that it is an essential part of an efficient enterprise, they will do it, and, I believe, find much greater satisfaction than in a happy-go-lucky muddle. Any day here you may walk into the tractor quarters and find them perfectly orderly and tidy. This is the rule on the farm in practically every building; and it should be so because, I think, efficiency in small things leads to efficiency in the bigger things. I try to facilitate this by a proper distribution of tools and other conveniences. You may not agree, but I think that the whole industry needs a general tidying up. In my opiniong this side of things should be more widely considered from the human and educative point of view, apart from anything else.

Mechanization and Greater Efficiency We are living in an age of increasing mechanization and improved equipment. This makes the agricultural world more attractive to the younger generation than under the older, slower and more arduous way of doing things, and from the national, as well as from the farm, point of view, it is well to keep a fair proportion of the community under the healthy conditions of the countryside.

I should probably have been quite happy to have retained the old way of life—before the mechanized age came in—but as it is here, I feel we have to use it to keep abreast of the times. We cannot put the clock back; therefore it is for us to make the right and best use we can of it. Many years ago, in the early days of motor cars, an old man complained to me about the dust they raised upon the road. My answer was: "You may be

able to do away with the dust, but not with the cars". Where mechanization is leading us I cannot say, but one thing I can say is that we must use it and not abuse it.

An intelligent tractor driver who looks after his machine with knowledge and care, and who takes great interest and pride in the work he turns out on the land, is surely a type of craftsman comparable with the carter and his horse equipment. Only the other day I complimented one of my drivers on some excellent ploughing that he was doing, and he expressed a wish that no other tractor plough should come into the field until he had finished. I do not begrudge my drivers time each morning to look over their machines and, if necessary, clean them down; all this tends to efficiency and personal interest in the work.

My head mechanic is surely a craftsman—a man with his whole heart in his work. I can turn to George for almost any repair, take-down or overhaul, or even improvisation, that I need. On the other hand, if the mechanical side of the farm is just neglected, machines and equipment left out in all weathers and used without care or personal interest, then of course it is a bad development. Is not mechanization in the agricultural world very much on a parallel with the other great scientific discoveries of modern times?—if they are used in the right way they are good, if they are abused, they are bad.

By means of improved equipment and really efficient management, we ought to be able to increase output per labour unit, leading to more economic production and a greater amount of leisure for the worker. It is not to long hours or low pay that we have to look for economic production, but to efficient and concentrated management and good equipment, introducing those fundamental principles of industry—good organization, standardizing where necessary, and turning out as far as possible a uniform product which appeals to the consumer.

Leisure and Education As regards more leisure and better pay for the worker, we must realize that conditions for the countryman have entirely changed, and many of the amenities that the town dweller enjoys are now available to the countryman; similarly, he is becoming more enlightened—one cannot expect him to sit down and watch a bus service continually passing through his village and not take advantage of it! This question of leisure or recreation is a big one, and closely associated with the all-important question of education. Universal education is still in its early days, and one of its objectives, if not its greatest, is surely to teach the individual how to use his leisure; in other words, how to express himself, and to encourage different forms of creative recreation rather than always requiring to be amused. Perhaps we might sum up the real object of education as teaching each rising generation to have a truer sense of values.

The land is a great heritage and it is our bounden duty to hand it on to the next generation in good heart and not merely to exploit it for our own immediate advantage. Few professions or commercial enterprises afford so great or so endless an interest as farming; in fact, after nearly thirty years, I still find not only an absorbing interest, but almost an excitement, in dealing with the land.

EAR TIPPING IN WHEAT

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CONSIDERABLE interest has centred around the white and shrivelled tips and upper parts of wheat ears this year. The proportion of the ear thus affected varies widely with different crops, and also within the same field, but all cases are characterized by similar symptoms—namely, dead spikelets with no grains developing. There has been some speculation as to the cause of this condition, which in severe cases may affect more than half the ear, and some growers have been concerned whether the trouble is due to infection by a fungus.

Observations at Cambridge Affected ears appeared on the wheat plots of the Cambridge University Plant Breeding Institute, where the conditions for studying the cause are particularly favourable because of the large number of different forms and varieties being grown in a comparatively small area. Examination of small dibbed plots of single plant selections from a Continental winter wheat showed that ear tipping did not occur at all in some selections ; others were only slightly affected ; and two or three were so severely damaged that more than half the ear of some plants was white and shrivelled. It was observed that the unaffected cultures were those which had shown early ear emergence, while the greatest damage occurred in the later cultures, which had also a more erect habit of growth during the winter and early spring. But the affected cultures did not show equal damage in all the plants ; those in the centre of each plot, where growth was poorest, were the most severely affected, while the well-grown border plants were either untouched or only very slightly tipped.

In the majority of cases, but not in all, the plants bearing the most severely damaged ears were poorly grown and considerably shorter in the straw than those that were undamaged. It was also apparent that on certain plants the earliest-produced ears were unaffected, while the back tillers bore damaged ears. Both these observations suggested that the time of ear emergence had something to do with the ear damage, a conclusion supported by the fact that the earlier cultures had largely escaped.

Top : Three ears from badly affected, short-straw plants. The sterility in the upper portions of the ears coincides approximately with the position of the flag. The fertile basal portions, which are enclosed in the leaf sheaths, are undamaged.

Bottom : Two badly affected ears from well-grown outside plants.

Left : Uninfected ear with the upper sterile portion shrivelled and turning white.

Right : Bunt, infected ear—with the upper sterile portion green and unshrivelled.

LIVESTOCK IMPROVEMENT DEMONSTRATIONS (See pp. 295-301)

The final clue was supplied by the position of the ear in relation to the uppermost leaf sheath in the badly affected plants. If Fig. 1, facing p. 318, is examined, it will be seen that approximately only that part of the ear which is exposed above the leaf sheath is damaged, and that that portion of the ear which was enclosed by the leaf sheath is unaffected. The inference is that in these cases the cold weather experienced at the time of ear emergence killed the flower parts and thus prevented grain setting in the exposed portions. This is further substantiated by the evidence from Fig. 2 (*ibid*), which shows two badly affected ears, one infected with Bunt and the other not infected. The infected ear was of the characteristic darker green associated with the disease, and this colour was retained right to the tip of the ear, while the uninfected ear was white and shrivelled where no grain had set. The presence of the fungus had caused the barren part of the ear to remain green although no spores had been formed because of the early death of the ovaries of the flowers.

Frost Damage at time of Ear Emergence It is probable, therefore, that the ear damage in these cases was due to the low temperature at the critical time of flower development prior to grain setting. It is known that some varieties of wheat are more susceptible to low temperatures than others at this stage, and it is interesting that the cultures most affected in this material studied at Cambridge were those which differed from the unaffected plants in their more erect, juvenile habit. It is also probable that the extremely dry conditions accompanying the low temperatures aggravated the damage, because in most cases the worst damage occurred in the poorly grown plants which were delayed in their ear emergence.

Although there is a similarity between damage caused by some forms of frost and that due to heat and drought, the symptoms here described appear to be due essentially to frost or exposure of the young ear to low temperature before fertilization of the ovaries.

Suneson has described similar damage in the U.S.A.,* and he was able to produce the condition by exposing wheat plants to artificially controlled low temperature conditions. His experiments showed that the sterility in the ear could be produced by exposure to conditions which either damaged all the floral parts and occurred only in those parts of the ear

*. *Journ. Amer. Soc. Agron.* (1937) **29**, 247–49; (1941) **33**, 829–34.

Livestock Improvement Demonstrations

Top (left): Livestock demonstration at Moulton, June, 1943. Mr. R. F. Hayward's progeny-tested sire takes the ring.
(Photo *Sport and General*)

Top (right): A yearling bull, his dam, and his sister, bred by Lord Lilford
(Photo. *Farmer and Stockbreeder*)

Bottom (left): A six-year-old bull kept under control by cable and chain.
(Photo. *Farmer and Stockbreeder*)

Bottom (right): Early maturity—a matter of "breed" and "feed". Northamptonshire Institute of Agriculture heifer, included in the Brampton Ash demonstration; subsequently first prize and reserve champion A.A. Show and Sale, Reading, February, 1944.
(Photo: *Claude Hosegood*.

which had emerged from the leaf sheath, or to conditions which injured the stamens only, in which case ears protected by the leaf sheaths were affected. He emphasizes the fact that the ears are sensitive to low temperature for a comparatively short time in their development. It is interesting also that Suneson refers to the shortness of the straw of plants with injured ears, with sometimes a failure of the ear to emerge from the leaf sheath. This condition, accompanied by delayed flowering of the undamaged portions of the ear, gives the general appearance of plants badly affected by drought, and is similar to the symptoms observed at Cambridge.

It is not suggested that all forms of ear tipping occurring in wheat crops in different parts of the country last season were due to low temperature injury, because, as has been stated, other climatic conditions can produce similar effects. It is worth remembering, however, that two or three cold nights with a few degrees of frost can cause the injury if wheat (or barley) is in a susceptible stage of development at the time. The subsequent appearance of the injured plants, with their short straw and poor development, then suggests extreme drought damage.

TWO IMPORTANT WHEAT PESTS

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IN the early months of the year inquiries were received from the eastern counties concerning damage to winter wheat by pests of various kinds. Apart from wireworm, the most important pests this year have been wheat bulb fly and wheat shoot beetle.

WHEAT BULB FLY

Wheat bulb fly (*Leptohylemyia coarctata*) has been recognized as an important pest for a long time, but the losses which it causes vary considerably from season to season. In the eastern counties during the early months of 1944 the incidence of attack by wheat bulb fly was exceptionally heavy, causing total loss of many wheat crops and considerable damage to many others.

The first sign of attack is usually noticed during March, when the centre leaf has turned yellow but the outer leaves still retain their colour. Where tillering is poor, whole plants may be killed, but where the plants have tillered well, some of these tillers usually escape and a satisfactory crop may result. If injured tillers are examined a small white maggot, varying in size according to the time of the year, can usually be found at or near the base of the central shoot.

Wheat, rye and barley are all susceptible to attack, but only when sown in the autumn or winter. (Couch grass is also attacked.) Oats appear to be immune.

Attack from February to Early May The flies, which resemble the common house fly, appear in June and may be found throughout July and August. Unlike other crop pests, they do not lay their eggs on or near the plants on which their larvae feed, but in bare or sparsely covered soil. Egg laying starts in July and continues throughout August, the flies dying soon after the eggs are laid. Most of the eggs remain unhatched until the following February, and then the small white maggots burrow into the shoots of wheat or other susceptible crops. If an unsuitable crop, such as oats, is sown in the field, the maggots die.

Each of the maggots may feed on several shoots, continuing its depredation until the end of April or early May, when it leaves the plant and pupates (as a brown chrysalis) in the soil near the plant. At the end of June or in early July each puparium may give rise to a fully grown wheat bulb fly.

Maggots resembling those of the wheat bulb fly may be found in wheat in late May and June. These are usually the maggots of the late wheat shoot fly (*Chortophila sepia*), a pest rarely sufficiently numerous to cause much damage.

Bare and Sparsely Covered Land encourages the Fly Apart from seasonal influences, the main feature of wheat bulb fly attack is that it follows certain rotational and cultural operations which, although not bad in themselves, appear to give rise to trouble from wheat bulb fly. It is, therefore, the modification of normal farming practices and attention to certain other features which will prevent or minimize losses due to this pest.

It is usually accepted that the fly lays its eggs in bare, loose soil during July and August. This is probably true and no doubt bare or bastard fallow would be the ideal egg-laying ground for the fly, but this year attacks most commonly occurred to wheat after potatoes or sugar beet. Potatoes and sugar beet would therefore appear to be favourite crops for egg laying. Wheat following ryegrass and clover leys was also attacked by wheat bulb fly, but in all instances the leys were ploughed up or cultivated (riffled in Norfolk) in July. On the other hand, there was no record of wheat being attacked after corn, beans, mustard or flax, or after any crop which covers the land thickly in July and early August. In districts where wheat bulb fly is known to be an important pest it is therefore risky to take wheat after a fallow on any crop which leaves much of the soil exposed during July and August—for example, potatoes, sugar beet and early broken leys.

With some fallow fields and crops lifted early—for example, early potatoes—mustard or rape for ploughing in or folding should be sown with the object of keeping the land covered from as early as possible in July to the first week in September. Growers whose land is scheduled under the Sugar Beet Eelworm Order, 1943, should remember that mustard and rape and other cruciferous plants are hosts of the sugar beet eelworm, and in these areas other crops should be used for covering the bare soil.

Avoid January and February Sowings During 1944 it became clear from records of attacked crops that the greatest damage resulting in crop failures usually occurred to wheat sown after the middle of October. The governing factor is the amount of tillering which takes place before the winter. In some districts, such as the black fen, wheat tillers freely with later sowings, and it is not usually necessary to sow wheat until mid-November. This can be seen from the following figures, which are estimates of the degree of attack based on counts of affected tillers of wheat taken after sugar beet in a black fen district of Cambridgeshire.

Date of Sowing	Percentage of Shoots Attacked
November 20	13
January 22	61

The November sowing tillered considerably, but with the January sowing the wheat was still in the single-shoot stage and half the total number of plants was destroyed. Any means, therefore, by which the plants may be stimulated to tiller before the winter will help to lessen the loss from wheat bulb fly attacks.

Further counts showed that spring-sown crops escaped damage if they were sown after March 1, as by that time apparently all the wheat bulb fly eggs had hatched. Thus, attack is liable to occur to January and February sowings, but not to March and later sowings.

No Resistant Varieties A wheat variety trial with 14 varieties* on black fen soil in Cambridgeshire was attacked by wheat bulb fly. Counts of attacked shoots showed that all varieties were equally attacked, no variety being more resistant than any other. This observation will probably hold good for other soils. Provided, therefore, that the variety most suited to the soil is sown, it is unlikely that any varietal resistance is worth considering.

On suitable land wheat has a remarkable power of recovery, and if the attack is noticed in its early stages much good can be done by rolling to consolidate the soil around the plants and to assist tillering. A top dressing of a nitrogenous fertilizer in the early spring is also helpful to the plant and will often assist recovery.

If a crop is badly attacked it should be ploughed up in early April and sown with barley. By this action weeds are given no opportunity to establish themselves, and a good crop of barley usually results. Barley is also suitable for patching a partial failure of wheat. Oats sown as late as this are liable to attacks by frit fly.

WHEAT SHOOT BEETLE

Damage to winter wheat in the eastern counties by the larvae of the wheat shoot beetle (*Helophorus nubilus*)† has been a common occurrence in the early part of this year. The first record of serious damage in this country occurred in 1934, when a number of wheat fields in Cambridgeshire and Norfolk suffered severely from the pest. Since then much damage has been caused in some seasons, while in others there has been very little.

* Jubilégem, Squarehead's Master, Cote d'Or, Desprez 80, Gartons 60, Scandia, Yeoman, Holdfast, Bersée, Little Joss, Steadfast, Hybrid 27, Hybrid 40, Chevalier.

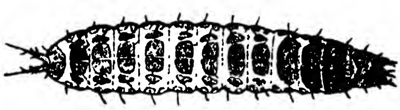
† Also known as *Wheat Helophorus* and *Empleurus nubilus*.

Attack from January to Early April Attack by the grub of the wheat shoot beetle starts in January and continues until early April. The very earliness of the damage should direct suspicion to the presence of this pest, since it feeds considerably earlier than either wireworm or frit fly. At first sight the injury suggests wireworm and, indeed, is often so attributed, especially when they are known to be present in the field. On careful examination, however, it will be noticed that there are more green leaves showing in the injured part of the row than would otherwise be the case.

Careful examination of the plants has revealed several kinds of injury:

1. **Below the bottom node or swelling.** The stem is completely severed, the injury resembling that sometimes caused by wireworm Under suitable soil conditions plants may send out fresh rootlets from the bottom node and re-establish themselves.
2. **Just above the bottom node.** A small hole, much smaller than the usual wireworm hole, can often be found. Frequently the central shoot is eaten through and turns yellow—an injury resembling frit fly damage, which is often seen on wheat after a ley.
3. **Well above the bottom node.** Sometimes the central shoot is damaged or severed just above the base of the highest expanded leaf blade.

Careful Examination necessary to discover the Grubs Eggs of the wheat shoot beetle have not been found, but observations suggest that there is only one generation a year. The larvae appear to overwinter, feeding on the wheat from January to April, after which they pupate, normally emerging as beetles in May and living until October.



Full-grown larva of the Wheat Shoot Beetle. (*Actual length three-tenths of an inch.*)

In early stages the wheat shoot beetle grub is of a brownish colour, but when fully grown it is three-tenths of an inch long and the body is of a creamy white colour overlaid by rows of brownish plates on its back and sides; it somewhat resembles a number of predacious beetle grubs found in the soil. The grubs are by no means easy to find, even when they are present in fairly large numbers; and it is only very occasionally that the grubs are found with their heads inside the plant. If no grubs are seen on lifting the plants, the top inch or so of soil around the plants should be examined carefully.

Field Observations The tilth of a wheat field is a factor which appears to have an important influence on the severity of the damage caused by the wheat shoot beetle. This is also true of wireworm, wheat bulb fly, frit fly, and other pests which attack wheat in its early stages. In many of the fields examined the tilth was very loose, and at the time of attack each plant consisted of one shoot and primary roots. Under these conditions the plants are easily killed if eaten through below the bottom node. Some parts of a field had a firmer tilth, and here the wheat had started to tiller and was sending out secondary roots. In such places many of the plants recovered from the damage, and when eaten through below the first node the secondary root enabled the plants to re-establish themselves, although the outer leaves had turned yellow

From numerous records it is concluded that an attack by the wheat shoot beetle on a wheat crop appears to be determined by certain pre-

disposing conditions and cultural operations which can be summarized as follows:

1. Damage to wheat occurs after leys and particularly after ryegrass and clover, but damage also occurs after sainfoin or trefoil. Except occasionally after cereals, wheat after other crops does not appear to be attacked.

   Many crops of wheat sown on ploughed-out permanent grassland have been examined without finding any wheat shoot beetle damage. The beetle, however, does occur in permanent grassland, as it has been found during sampling of such land for wireworm; but whereas attacked wheat fields after leys have yielded on the average about 300,000 grubs per acre, grassland has seldom produced more than 25,000.

2. No serious damage by wheat shoot beetle has been recorded in leys broken up in August. In all cases recorded, the leys had been broken up in September and October.

3. Date of sowing has an influence on the damage sustained. Wheat sown in early October has tillered and formed secondary roots before the main attack begins. Wheat in this condition appears to be able to withstand attacks. Wheat sown later, as a rule, takes much longer to germinate and is still in the single-shoot stage when the attack starts, and is very easily killed.

4. Damage usually occurs on soils of light or light to medium texture, such as the light Norfolk soils or the light soils in the east Cambridgeshire area. No investigation has yet been made on heavy soils.

The following are details of a typical field which provided some interesting information. The soil was a light chalky loam, and although the whole field was under wheat, it can be divided into three parts, A, B and C:

	Drilling Date	Previous Crop	Condition of Wheat
A	November 3	Peas	Fair
B	November 3	Sainfoin	Failed
C	October 15	Sainfoin	Good

The field was mucked before ploughing. No damage from wheat shoot beetle was found on A, but damage was found on both B and C.

The population of wheat shoot beetle grubs was estimated separately for parts B and C, and both proved to be exactly the same (within the limit of the method) at 375,000 grubs per acre. Part B was a failure and was ploughed up, but part C was a good plant and no damage was suspected on this part of the field.

Recommendations Farmers on light soil who grow wheat after a short ley can avoid damage by the wheat shoot beetle by ploughing not later than August. (Ploughing leys before harvest also prevents frit fly damage to wheat.)

Wheat should be sown before mid-October on a good firm tilth; the damage caused by the wheat shoot beetle and other pests is then very much reduced. Late sowings, especially November sowings, are attended by serious risks.

If the crop is badly attacked at the end of March, it should be ploughed and drilled with barley. Barley may also be used for patching a poor plant.

CHOCOLATE SPOT OF BEANS

W. A. R. Dillon Weston, M.A., Ph.D.

School of Agriculture, Cambridge

THE Chocolate Spot disease of broad and field beans occurs in a mild form almost every year, but epidemics are relatively infrequent. The symptoms range from a characteristic spotting of the leaflets and streaking of the stems to an acute condition where the diseased areas merge, causing partial defoliation, blackening and death of the plants.

Non-aggressive and Aggressive Phases The first form of infection, which results in the typical well-defined chocolate-coloured spots, occurs almost every year from December onwards, but the injury which it causes is seldom severe. This is the "non-aggressive" phase of the disease.

The second type of infection which causes blackening and death of part or the whole of the shoot system is the "aggressive" condition, and it is this which causes the damage when epidemics occur. This phase is usually limited to the months from April to July, and if abnormally heavy rainfall occurs in these critical months, epidemics may be expected.

What is the Cause ? At one time Chocolate Spot was thought to be caused by a bacterial disease, but research by Dr. A. R. Wilson, then working at the Botany School, Cambridge, showed that this was not so, and that the disease was caused by the Grey Mould fungus, *Botrytis cinerea.*

How do the Spores reach the Plants ? *Botrytis* is a very common mould fungus which grows upon dead or dying plant tissue where, if weather conditions are favourable to its growth, it produces spores abundantly. It is these which are caught up in wind currents and then settle on healthy leaves and stems. A very fertile breeding ground for these spores is on bean shoots which have been killed by frost, for on this dead or dying tissue the fungus breeds profusely. Later these spores infect healthy tissue on newly formed shoots.

Conditions which favour Epidemics Any factor which weakens the crop, such as sour soil, potash and phosphate deficiency, water-logging or a profusion of weeds, makes it more liable to the "aggressive" type of infection. The disease is favoured too by a dense stand of beans and shelter from the prevailing wind, and, as already stated, epidemics may be expected with abnormally heavy rainfall during the months of April, May, June and July.

Can the Disease be Prevented ? No satisfactory method has yet been found, but the chances of damage may be lessened by correcting, where possible, those conditions which favour the disease.

Other Damage that may be confused with Chocolate Spot It should be noted, however, that not all chocolate-coloured spots and streaks on beans are due to *Botrytis.* Frost, besides causing blackening and scorching of the shoots, also gives rise to brown flecks or bronzed areas. Brown or bronze spots are also formed by the leaf-spotting fungi, *Ascochyta Fabae* and *Cercospora Fabae.* A black fly attack too may cause chocolate-brown markings on the foliage.

See illustration overleaf


THE
CHOCOLATE SPOT DISEASE
caused by the fungus
Botrytis cinerea
FROST predisposes the crop to the disease.
For further information consult your WAEC or Provincial Advisory Department
1
AUTUMN • EARLY WINTER • MILD WEATHER
The beans are sown
2
LATE AUTUMN • EARLY WINTER • MILD WEATHER
The seedlings are forward but growth is sappy and not hardened off owing to mild weather.
3
LATE WINTER • EARLY SPRING • WINDS & FROST
Sharp frosts & winds check the forward plants & shoots may turn black and die.
4
MILD SPRING WEATHER
THE FUNGUS ENLARGED
Spores of the common grey mould fungus (Botrytis) settle on the damaged tissues & become parasitic.
5
FINE SPRING WEATHER
In favourable weather a lateral bud breaks and a healthy shoot is formed.
6
SPRING & SUMMER • SHOWERY & WARM
O-SPORE
Spores formed on the dead tissues fall on the young leaves
7
SPRING & SUMMER • SHOWERY & WARM
Red spots & blotches appear. This is the 'non-aggressive' form of the disease.
8
VERY WET PERIODS FROM MAY-JULY
In very wet weather the disease may become 'aggressive' and kill the whole plant
9
THE FORMS OF CHOCOLATE SPOT DISEASE
'AGGRESSIVE' 'NON-AGGRESSIVE'
Do not confuse these symptoms with the red marks caused by frost and Aphis.

HARVESTING AND DELIVERY OF SUGAR BEET

H. WICKENDEN

British Sugar Corporation

THE series of autumn operations culminating in the extracting and refining of sugar is known as the "campaign". The name is appropriate since it is in fact a combined operation of some magnitude, where the farmers and their workers, the railways and the road hauliers co-operate with the factory to produce the maximum quantity of sugar and beet by-products before the storms and frost of winter slow down work in the fields, make transport difficult, and restrict factory through-put if frozen beet have to be processed.

War-time demand for home-produced sugar has expanded the acreage of beet to be dealt with, and the efficiency of the eighteen beet-sugar factories in Great Britain has been stepped up to meet this need. Nevertheless, it is most desirable that sufficient sugar beet should be harvested so that deliveries can begin from mid-September onwards, according to district, and proceed in an orderly and regular flow for the following thirteen weeks or so. The farmer is anxious to clear his fields and perhaps to sow winter wheat ; he wishes also to cash his crop and receive the pulp back from the factory to feed his stock. With these objects in mind, therefore, the grower plans his beet harvest.

Time of Harvesting Sugar-beet deliveries are controlled by loading permits (similar to railway tickets) issued by the factory. The object of the permit system is twofold: firstly it ensures that the movement of beet to the factory is maintained at an even rate, and secondly, that growers receive fair treatment. The factory must safeguard its supply of raw material, but the special requirements of growers are considered when the allocation of loading permits is made. First then, the grower should examine these permits immediately they are received from the factory. If October permits are included it is not advisable to harvest more of the crop in any one week of that month than will supply the tonnage required for delivery. In the first place the beet will probably be increasing in weight and sugar content. Secondly, the beet will lose weight if left too long uncovered on the field or in heaps by the roadside ; October is too early to clamp beet.

During November the tempo of beet harvesting should be increased and the aim of every grower should be to have all sugar beet out of the ground by the end of November ; the risk of frost and generally unfavourable weather increases after that date.

Under the contract it is the grower's responsibility to deliver his beet in sound condition for sugar manufacture. Frost seriously damages beet, particularly where the roots are subjected to alternate freezing and thawing, and the practice of pulling and laying out large acreages of beet and leaving carting off until all the field is pulled and topped cannot be too strongly deprecated. Beet which is not covered by delivery permits for immediate loading should be carefully clamped ; the best way to do this is explained later.

Lifting For small acreages and where horses are used there is no better tool for lifting beet than the side-lifter as made by several of the well-known firms manufacturing ploughs. There is no advantage in using the double-share type of lifter ; indeed on strong soils it does not make such a clean job as the other. On the really light soils a lifter is often unnecessary and the beet can be pulled by hand ; in parts of Norfolk and

Suffolk a short-handled two-pronged spud is still used extensively, and in the hands of experts lifting and knocking can proceed at a rate which compares favourably with the horse-drawn lifter.

When a beet lifter cannot be obtained it is quite feasible to lift sugar beet satisfactorily with an ordinary digger plough by removing the mouldboard or breast. On larger acreages sugar beet is now almost entirely lifted by tractor-drawn lifters constructed to take one to four rows.

Knocking, Topping and Piling The operations of knocking, topping and piling are much more important than some growers seem to realize. Carried out efficiently, time and money can be saved, and carriage costs reduced by sending clean beet to the factory instead of quantities of good top soil which embarrass the factory and should be retained on the farm. Above all, by carefully piling the tops and crowns *as they are cut off* they will be preserved as stock food with little or no loss.

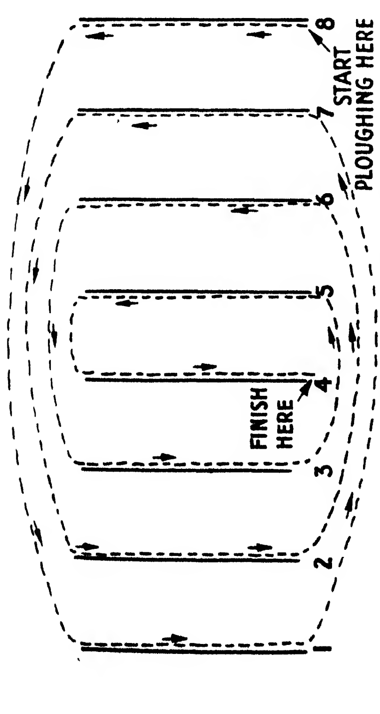
An increasing number of farmers are recognizing the dual-purpose value of the sugar-beet crop; first, there is the cash crop sold to the factory for the production of sugar, and secondly, there remain the leaves and crowns which, to the dairy farmer, stock-feeder or flockmaster are no less important. If these tops are merely cut off and scattered over the field, a large percentage will be damaged in the process of carting off the beet. To avoid this loss and to economize in time, many growers adopt a system of ploughing out, pulling and topping as shown in the diagram opposite.

The field is divided into sections of eight rows. These are ploughed in the following order: row 8, 1, 7, 2, 6, 3, 5, 4. The space between rows 4 and 5 is cleared and reserved for piling the topped beet, and beet tops and crowns in alternate heaps. Two rows are laid into one (tops outwards) as they are pulled ready for topping, and the roots and tops from these double rows are put into one final row of heaps down the lane between rows 4 and 5. Thus all the space between every eighth row is clear for carting.

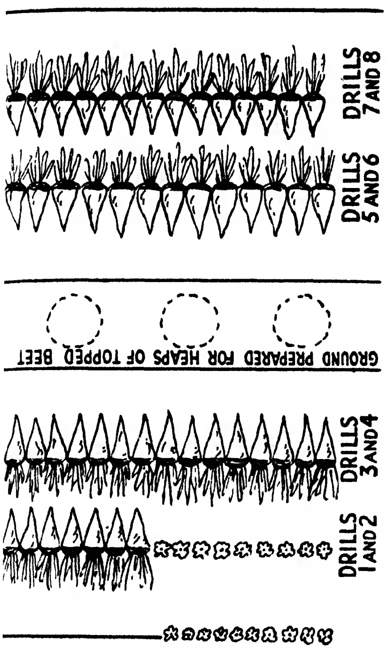
If a sugar beet is examined a deep groove will be seen on two sides of it, known as the sugar groove; elsewhere the root is comparatively smooth. When knocking the beet to remove surplus soil a plant should be grasped in each hand by the top and the roots struck smartly together so that the smooth surfaces of the two roots meet and not the grooved ones. This simple tip will save many a hundredweight of "dirt tare deduction" for the grower.

As regards topping, the aim should be to comply with the contract conditions without removing too much of the root. The clause referred to allows the factory to re-top, if necessary, any beet in the sample "squarely immediately below where the lowest leaves or buds on the crown only have grown". The top tare thus obtained is expressed in lb. per cwt., and is shown on the returns sent back to the grower weekly by the factory. A "nil" top tare would indicate that too much is being removed in the field; on the other hand, if returns are received showing 4 lb. or more per cwt. the workers should be urged to top more carefully, and particularly to see that the crowns are removed squarely across the top of the beet.

Some growers consider that the lifter should be put through the crop some days ahead of the pulling and topping to allow the tops to wilt, the theory being that sugar present in the tops finds its way to the root and thus increases its sugar content. There is no scientific proof of this theory, but for convenience it is usually advisable for the lifting to be a day ahead

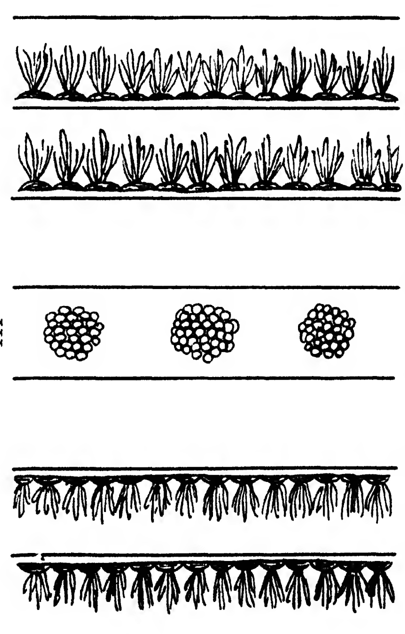


First stage.—Ploughing to leave clearance space.



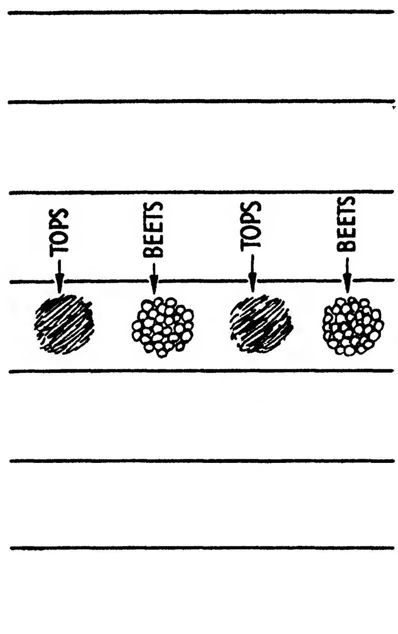
Second stage.—Appearance before beets are topped.

III



Third stage.—Beet in heaps after topping.

IV



Fourth stage.—Preserving the tops in heaps between beet.

of the hand work, and if sheep are to be folded on the tops immediately, or the tops fed to cattle, a wilted condition is advisable, since it reduces the possibility of the presence of oxalic acid in the tops.

Carting Off and Loading Sugar-beet forks fitted with blunt-ended tines are used by most growers for loading the beet into carts, or early in the season when the ground is hard directly into lorries, thus saving double handling. A point to bear in mind is that no hing but beet is required at the factory. All loose beet leaves, straw and other trash, especially stones, should be excluded; they only cause delay and sometimes damage to factory machinery and may well have adverse repercussions on the rate of delivery—damaged slicing knives caused by stones can result in serious delays in the factory, and quantities of trash passing with the beet into the washers are a constant brake on throughput.

Clamping It is obvious that as there is sufficient national tonnage of beet to keep the factories supplied until the end of December, approximately one-third of this tonnage will have to be held on the farms until that month, or even later. It has already been pointed out that generally speaking it is advisable to finish lifting and carting off beet by the end of November; therefore beet covered by December permits should be carefully clamped.

Widespread experiments on the best methods of clamping were carried out in 1942 by the Sugar Beet Research and Education Committee in collaboration with provincial advisory chemists and factory agriculturists of British Sugar Corporation. The winter was mild, but valuable information was obtained which has been summarized in a leaflet available to any grower on application to his factory or fieldman.

Briefly stated, the experiments showed the advisability of building fairly large clamps of 40-50 tons rather than smaller ones. The clamp should be about 8 ft. wide at the base, rising in the shape of a cone to a height of 6 or 7 ft. The beet at the sides and ends should be carefully packed with the crowns outwards, and no beet should be put into a clamp unless it is properly topped. A covering of hedge or dyke trimmings or straw, preferably in bundles for easy removal, is strongly recommended. Soiling down as for potatoes is unnecessary, but spadefuls of earth should be used to keep a straw covering in place.

Beet that have been injured or show signs of disease should not be clamped; neither should frosted beet.

The site of the clamp should be dry, well drained and preferably near a hard road and protected from the prevailing winds, as shrinkage will tend to reduce the weight.

A Mechanical Sugar-beet Harvester The reaper and binder revolutionized corn harvesting; and the combine has carried this development a stage further. Not only has it removed the backache from the harvest field, but it enables the farmer to face the prospects of a showery "back-end" with equanimity.

The day is fast approaching when an efficient, moderately priced sugar-beet harvester will do all this for the beet crop. Harvesting sugar beet will then be greatly reduced in cost, in length of time and in hand labour difficulties. Many inventors, both on the Continent and in the

U.S.A., have endeavoured to produce the fool-proof beet harvester, and at least one British machine, the Catchpole harvester, has made a useful contribution towards solving the problem in this country.

This machine was designed primarily to lift, top and deliver sugar beet in one operation on medium and light soils. Under good conditions the Catchpole will harvest 1½ to 2 acres per day and leave the beet in orderly windrows ready for carting off. Two men can operate the machine, but it is usually necessary to have one or two additional workers in the field to re-top the small percentage of roots missed by the automatic topping unit. Other improvements are pending, and there is every prospect of this all-British harvester becoming standard equipment of the large sugar-beet growers when post-war conditions permit production to be expanded.

MACHINERY EDUCATION IN BUCKINGHAMSHIRE

E. J. HUGHES and P. G. DELINGPOLE, N.D.A.

Buckinghamshire War Agricultural Executive Committee

HUNDREDS of farmers with experience only of grassland management have, since the war, been called upon to operate arable machinery for the first time. In Buckinghamshire, which is mainly a heavy land county and before the war grew good grass, there were many such inexperienced men. The older generation, under compulsion of war-time need, transferred their attention, if not their affection, from horse to tractor, but they had to be persuaded that it was as necessary to bestow just the same care on the one as on the other. The young operators were keen but, of course, required to be helped in every possible way. It was clear very early that if the job was to be tackled effectively help would have to be enlisted from farmers and their workers, parish machinery pools, and established organizations such as Young Farmers' Clubs, National Farmers' Union branches, etc., which are in a good position to give the project a flying start. This has proved a sound policy.

Preliminary Arrangements In each district in which it was proposed to hold a class a meeting place had to be found which was also large enough to house farm implements. Often this was a barn, sometimes a garage, occasionally a smithy. The building had, of course, to be blacked out, braziers improvised, and often we ourselves had to wire the place with temporary lighting from the main circuit. A good light is essential where intricate work with machinery is to be attempted: oil lamps are useless.

A provisional syllabus covering instruction in tractors and general farm machinery was drawn up, but in almost every instance it had to be modified or extended in some detail to suit the requirements of the people attending the class. The chief difficulty was to decide where to draw the line. If the lesson becomes too complex, interest naturally wanes. A typical syllabus last winter comprised:

- Tractor maintenance and operation.
- Tractor trouble hunting.
- Decarbonizing and grinding in the valves of a Fordson Tractor.
- Removing tractor clutch and explaining its use and abuse.
- Dismantling gears, worm wheel, crown wheel and differential, and explaining their functions.
- Ploughs, ploughing and plough-setting, illustrated with films.
- Talk and demonstration with mowers and binders.
- Talk and demonstration on grain and fertilizer drills.

Altogether we ran twelve complete four-month courses between October, 1943, and March, 1944, which, with film shows on machinery, talks to discussion groups, etc., filled five out of seven evenings every week.

The syllabus, together with details of time and venue, was circulated to farmers known to be interested. They were also asked to pass on the notice to their workers. Experience has shown that individual invitations sent directly to the farm produce better results than the insertion of a notice in the local newspaper or the display of posters in the village. Generally, however, all three methods of advertising are used: the advertisement and posters at least serve as reminders, and are useful should the course be extended.

Everything has, of course, to be prepared in advance, notably arrangements with a local farmer to borrow implements (in this farmers everywhere co-operated most willingly) and, once secured, their preparation for demonstration. Often this meant taking off a tractor cylinder head, "splitting" to expose the clutch on tractors, or jobs such as dismantling the knotter on a binder. To arrive without the necessary tools, and to deliver a hesitant, impromptu commentary, is to court failure. Clear charts, diagrams and photographs which aim at impressing certain specific points must be suitably mounted and well displayed.

Then the Class If the preparation has been thorough the evening's work should cause no perturbation, provided the time has been well chosen and does not clash with local affairs or social arrangements. The demonstrator must not lecture: he must encourage everyone in his audience to express his own views, stimulate arguments where necessary, and above all get tractor drivers themselves to try grinding-in valves, decarbonizing cylinders, assembling clutch plates, etc. These manual processes and the lively arguments which ensue add to the interest of the evening and help the man who is going to do the job to solve his own particular problem—and this, after all, is of greater personal importance to him than anything the Tractor Instructor may stress. That farmers and farm workers in Buckinghamshire have appreciated this method of education is shown by the good attendances we have had; even in the worst winter weather, and in remote districts, enthusiasts have cycled ten miles or more every fortnight for four months, never missing a single class.

Development from Classes Field demonstrations have been the natural development of evening meetings. These have taken the form of ploughing and plough-setting with a dynamometer, ploughing matches, binder adjustment and drill calibrating.

One interesting development was an "inventions evening," to which members brought their own inventions and adaptations. These showed a surprising range of ingenuity. The entries ranged from a special grain tank for use with a combine harvester to a gadget for making ropes from used binder twine, and included a lime spreading machine and a patent clasp for hawsers, a dual-purpose fork, an adapted plough hitch, a one-man drill, a Fordson hand clutch and a drawbar for attaching a horse-mower to a tractor. It is obvious that this kind of thing could be extended to cover greater areas and so bring useful suggestions, already in use perhaps on individual farms, to the notice of the whole farming community.

Films showing subjects of both general and particular interest have been exhibited and appreciated. Agricultural machinery "Bees," which are not only entertaining but can be used to convey a vast amount of useful

information, have been highly successful. Once having broken the ground it is important to maintain contact, and in this connexion a tour of local markets with machinery exhibits has proved most useful during the busy months.

Future Possibilities We have now reached the stage when we feel that we must cater not only for the general farm worker who drives a tractor but also for the man who wants to study the subject more deeply. This can probably best be achieved by short specialist week-end courses embodied in a long-term plan which will continue after the war. Manufacturers will be asked to co-operate by demonstrating the most modern machinery, so that the farmer who cannot go to the "Royal" can have an opportunity of seeing and assessing the value of modern tackle before perhaps it arrives on his neighbour's farm.

There is no question of the genuine desire for knowledge about farm machinery. Farmers wish not only to get the best out of the machinery they already possess, but also to make full use of new machinery where it is proved to be better than the old.

MECHANIZING THE POTATO HARVEST

National Institute of Agricultural Engineering, Askham Bryan, York

THE plough and potato spinner are still the two most widely used implements for harvesting potatoes. During recent years the chain elevator digger has become increasingly popular, particularly with the larger growers. Several advantages are claimed for it, but of these the two most important under war-time conditions are that pickers can work faster behind the machine than behind the plough and spinner, and that it lifts the crop more completely.

The mechanization of the potato harvest has now been carried a stage further by the introduction of the complete harvester, which either delivers the crop into carts or trailers or into bags. The problems confronting the inventors of such machines are : the complete separation of the potatoes from haulm, weeds, soil and stones, and the delivery of the potatoes undamaged into carts or trailers. With one exception, all the complete harvesters that have so far made their appearance make use of the chain elevator digger to lift the potatoes. Only under exceptional conditions can the elevator digger effect a complete separation of soil and potatoes. When the soil is cloddy severe agitation of the elevating chain sufficient to break down the clods would damage the potatoes. To date, no satisfactory method of separating the potatoes from soil and stones has been evolved, and until it is the separation will have to be done by hand. On present-day machines either the potatoes are taken from a conveyor belt and placed on special conveyors which take them to the bagging platform or, as is more usual, the rubbish is removed and the potatoes allowed to continue up the conveyor into a cart or trailer.

Spraying the crops with sulphuric acid or other suitable materials greatly reduces the bulk of haulm to be handled and destroys the majority of the weeds. The dead haulm has still to be removed, and this is usually done by a conveyor with widely spaced rods, through which everything falls except the haulm.

FARMING NOTES

Bluestone to Preserve Fence Posts The superficial treatment of farm fence posts, such as dipping them in a preservative for a few minutes or applying the preservative with a brush, will not prevent decay; indeed, for all the protection that such scant treatment confers, they may just as well be left untreated. Soaking in a solution of bluestone (copper sulphate), 2½–3 lb. per gallon of cold water, has proved a highly effective, yet simple and economical method of preservation in trials carried out in the Prairie Provinces.*

Only green or unseasoned posts respond to bluestone treatment, which consists of placing the peeled butts in the solution to a depth of 18–36 inches. As moisture is lost at the top of the post, the bluestone solution permeates the length of the post to replace it. The upward movement of the preservative may be watched by peeling a strip a few inches wide along the side of each post. When the solution is seen to have reached the top the treatment can be considered completed. Outdoors on a warm spring day this should not take much longer than 12 hours.

Tailings and Screenings of 1944 Cereal Crops The use by farmers for feeding to their stock of tailings and screenings from their grain crops is strictly controlled, and all growers of cereals should note carefully the provisions of the new Statutory Orders governing the use that may be made of these by-products during the 1944–45 season.

Under the Orders growers may keep for use on their own farms tailings or tailings and screenings from any threshing of wheat, rye or barley, provided the quantity kept does not exceed a specified percentage of the total weight of grain (including the tailings and/or screenings) produced by each threshing. The permitted percentages for each kind of grain are as follows:

	Per cent. of Total Weight of Grain Threshed
Wheat (Tailings)	5
Rye (Tailings and Screenings)	5
Barley (Tailing and Screenings)	
(1) When threshed during August or September, 1944	5
(2) When threshed during any month from October, 1944, to July, 1945, inclusive	10

For the purposes of the Orders, *tailings* are broken, small or immature grains with or without other material separated in the course of threshing.

Screenings of rye are "the residue of grain remaining when the maximum quantity of millable, potentially millable or seed rye has been separated from any parcel of rye".

Screenings of barley are the "grains separated from the bulk by a mechanical process of sifting (in the course of threshing or subsequently) and which are smaller or lighter than the average size or weight of grains in the bulk".

The fact that growers may not keep for their own use more tailings or screenings than the permitted percentage does not mean that a greater percentage should not be separated out. If this would improve the quality of the head corn, it would be good practice and to the ultimate advantage

* Edwards and Walker, *Scientific Agriculture*. April, 1944.

of the grower to do so ; but any excess must be sold to an approved buyer unless certified as non-millable or, in the case of barley, as not suitable for human consumption. Any tailings or screenings which a grower, although entitled to do so, does not wish to keep for his own use, may be disposed of only to an approved buyer, except with the special authority of the Ministry of Food.

Sheep on Sugar-beet Tops without Scouring From time to time trouble occurs through sheep scouring when fed on sugar-beet tops. It has been shown, however, that scouring can be prevented by care in feeding and management. Here is a case in point. Some lambs bought in September were grazed at the outset on stubbles, and subsequently on aftermath and young seeds, until the beginning of November, when they were put "on and off" sugar-beet tops for a fortnight. Thereafter, they were kept full time on the beet tops. They were given ½ lb. per head daily of concentrates consisting of a mixture of crushed peas and oats, with ground chalk added to the concentrates at the rate of one-third of an ounce of chalk to each ½ lb. of meal.

The lambs throve well throughout and there was no scouring. It is believed that the principal factors which contributed to this end were that the lambs were brought *gradually* on to the tops (over an introductory period of a fortnight) and the inclusion of the specified quantity of ground chalk in the daily ration of meal.

NOTICES OF BOOKS

The Farming Front. FRED KITCHEN. Dent. 1944. 12*s*. 6*d*.

Any book that is to become popular must not merely detail the facts of ordinary life. Probably few readers wish to look into a mirror, yet Fred Kitchen's faithful picture of farming in two years of war should, and probably will, be widely read. Country life and work is presented with no glossing over of its hardships and without over-statement of its advantages.

Belonging to the community of which he writes, Mr. Kitchen has a fund of local stories. He sympathizes with the views of Tom Paley, the wagoner, that "Farmin' 'as to be done methodic like," and (speaking of tractors) " . . . no amount of speeding up will alter seed-time an' harvest".

Harold Burdekin's camera has captured some excellent photographs to illustrate the book, and these are of more than usual interest in that they deal with the work going forward on the farm and, in part, with the personalities of which Mr. Kitchen writes.

Farming Front avoids controversy but, for all that, it is likely to help promote a better understanding of the countryman, since it depicts him as a skilled workman dealing, not with controllable factors, as in industry, but with the vagaries of climate and the living soil.

Use and Development of Agricultural Machinery During the War. Pamphlet No. 11). S. J. WRIGHT. Bath and West and Southern Counties Society. 1944. 1s.

Details of many of the war-winning achievements in the science of engineering will not be disclosed until victory has dispensed with the need for secrecy. But accounts of developments in agricultural machinery are not subject to censorship and it is possible, therefore, to survey the improvements in farming machinery and technique made during the war years, and to assess the value of their contribution to the growing of Britain's food. This, Mr. Wright, Director of the National Institute of Agricultural Engineering, has done most ably.

It becomes clear from his account that although many new and ingenious machines have been evolved, for the most part the cultivation of this country's enormous war-time acreage has been done by types of machines which were already conventional before the war. War-time developments seem to have occurred not so much in the design of the machines as in an extension of the variety of work which they have been made to perform. This is particularly noticeable with tractors. Mr. Wright describes how the simple four-wheeled tractor has cultivated land which five years ago would have been thought to require a track-layer. He describes, too, the adaptations (some of them made on the farm) which have enabled these simple tractors to carry out inter-row work—another operation which was previously thought to be outside the range of any but the highly specialized row-crop tractors.

But discussion of war-time developments, in whatever field of endeavour they have occurred, leads inevitably to discussion of post-war possibilities, and many readers will turn to this 24-page pamphlet for its suggestiveness of future trends in agricultural engineering and farm mechanization. There is much food for thought, particularly in those chapters dealing with silage-making, dung-handling and root and vegetable harvesting.

The Farming Ladder. GEORGE HENDERSON. Faber and Faber. 1944. 8s. 6d.

This is the story of two brothers whose only initial assets were mental and physical vigour, a healthy ambition, a worthy mother and a steady determination to climb the farming ladder. They are not unique, even in agriculture, and yet how rarely the Hendersons of life have the time or the inclination to relate their experiences and reveal the secrets of their success.

The book is well worth reading as a study in personalities alone, for the Hendersons would have succeeded in any self-chosen career. But although they have achieved a substantial measure of financial success, their real interest has been the land and its development, and the mode of life of the farmer.

The book is written in a clear, confident, positive style, as one would expect, and it is pleasantly illustrated. It contains much valuable technical information and many examples of how difficulties were turned into opportunities by facing up to problems and making use of all available knowledge and facilities. It can be recommended as good reading to the general public, but every agriculturist from 16 to 60 should make it his business to study it with an open mind.

The Case against Pasteurization of Milk. JOHN P. BIBBY. Staples and Staples, 14 Great Smith Street, London, S.W.1. 1944 1s.

This book, by a well-known dairy analyst, is a reply to the case for compulsory pasteurization prepared by Professor A. S. Wilson, M.D., on behalf of the Ministry of Health.

He examines critically the nature and presentation of the vital statistics selected by Professor Wilson, and draws freely on other authentic research work to refute the conclusion that the pasteurization of milk does in fact save human life. He proceeds to condemn, in principle, the mass-processing of milk, which he claims greatly impairs its food value, and advocates the production of clean, raw milk from healthy herds, bottled on the farm.

By way of digression the author ventures into the field of human pathology, with several propositions for further study which may, he suggests, explain some of the anomalies in the statistics which he has examined and criticized.

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LATE-SOWN WHEAT

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Hertfordshire War Agricultural Executive Committee

THE first point to consider is at what date it may be said that wheat is sown late. This depends on the land, for the right date on some soils would be perilously late on others. On really good land the chief danger in wheat-growing is excessive growth in winter and spring, leading to severe attacks of Rust and Mildew, early lodging and badly filled ears. On such land "winter-proud" wheat must be avoided at all costs, and the common rule is not to sow a kernel before November; successful men have no qualms about continuing drilling well into December. But very little of our land falls into this category.

The Fertility Factor On medium and poor soils early sowing is good practice, and the poorer the soil the earlier should be the date of sowing. In this respect it is the inherent fertility of the land, rather than its present "condition," which must be considered; fallowing and generous manuring will make poor land crop more like good land, but they will by no means make up for late sowing. On poor light land the crop will not continue growing throughout the summer, and for a full yield considerable growth must be obtained in autumn; if it is thoroughly established in the back-end, it will get away quickly in spring, so that vegetative development may just about be completed by the time the soil dries out—around midsummer.

At the other extreme, clay soils lie very "cold" through the heart of the winter, so that seed may remain ungerminated or, worse still, the young shoots may just appear through the surface and remain in that stage for a long time, serving only to draw the attention of birds to the seed that lies beneath. Apart from birds, the seed and the very young plant are vulnerable to soil organisms; hence crops which are slow to establish themselves are usually thin and rarely yield well.

Poor land, whether heavy or light, should be sown by the end of October. The end of November is too late; the risks are too great. It is better to postpone the drilling of the land that remains until February, when soil temperature is rising and spring is just ahead.

The Right Cultivations Cases are often quoted of first-class crops resulting from mauling wheat into the ground, but these are exceptional and should not be held to illustrate good practice. All farmers know that an autumn seedbed should carry some clod, but it should also have plenty of crumb, so that the seed may lie snug; a quick germination and an even growth will then result. With late sowing a rapid start is all-important to the crop. If the land has been lying some time in the furrow it should crumble down well, and a stroke with the drag harrow, possibly followed by light harrows, should produce a good seedbed. Many farmers have come to rely almost exclusively on the disc harrow. This implement can be very useful, especially in dealing with turf, but for well-weathered furrows its action is quite wrong. The object is not to cut but rather to shatter the mellow furrows and build up crumb; this is just what the toothed harrow does. The cutting action of the disc confers no benefit in such conditions; indeed, on clay or unweathered land it often does positive harm, the cut surfaces it leaves being thoroughly "puddled" and very slow to break down. The fact that discs can produce passable seedbeds from upturned turf, when no other implement would produce a seedbed at all, should blind no one to its limitations where conditions are suitable for traditional implements.

In late November wet conditions must be expected, and it is often necessary to take advantage quickly of any dry patch of weather that may occur to complete the autumn drilling programme. It must be remembered that the land is thoroughly wet and all that can be expected are brief periods when the surface, and only the surface, will be just dry enough. The furrows may be getting green with annuals, perhaps chiefly black grass, and the land must be moved well to kill the weeds. If, however, the land is worked first, wet soil will be exposed and the drill will not run, so that the fleeting chance offered by the fairer spell of weather may be missed. In such cases it is best to put the drill over first, when its wheels will run clean on the relatively dry surface. Here, again, many farmers are tempted to use a disc drill and cut the seed in across the furrows, but a plain coultered drill with bar press will make a better job. With the seed in, the weeds can be killed with one or two strokes of the heavy harrow; in all but the wettest conditions this should produce some crumb and the final seedbed may be quite good. Tined harrows will give a better cover of the seeds than discs—and cover is supremely important in late autumn when birds are getting hungry. Bird-minding accords ill with the bustle of war, but, anyway, where rooks are concerned it should be possible to arrange a hedging or ditching job round a newly sown field.

Increased Seeding Rate and Generous Manuring When wheat is drilled in good condition in October some 60 or 70 per cent. of the seeds sown may establish plants, but as the season advances this percentage falls and may easily be halved. An increased seeding rate is therefore desirable. Whereas 2 bushels per acre is ample in October, the rate should rise to 2½ bushels by mid-November and to 3 bushels for the latter half of that month. In some districts there is a tradition in favour of higher seeding rates, rising to 3½ bushels or even to a full sack in late autumn, but the writer has seen no evidence in practice that these higher rates are justified.

The manuring of late-sown crops should be generous to make the crop come away quickly, and drilling artificial manure with a combine drill is most efficacious in this respect. Though a plain coulter drill is generally to be preferred to one with disc coulters, it is better to use one of the latter with a manure box on it than one of the former without.

Variety to Suit the Soil Among autumn varieties there is not very much difference in time of maturity, and selection from them cannot be relied upon to overcome lateness of sowing. Rivet wheat is well known to be late, the difference in that case being appreciable, so that Rivet should never be sown later than the first week in November. Of the remainder, Little Joss is generally regarded as an early ripening variety and therefore recommended for late sowing, but the difference in its favour is slight and in fact has been very difficult to detect at all in the 1944 harvest. The rule should be to choose the variety to suit the land rather than the date of drilling. Little Joss, Holdfast, Yeoman, Squarehead's Master, Vilmorin 27 and Desprez 80 (probably Bersée and Jubilégem could also be included) have a good chance of success if sown by early February, but that should be regarded as the final date. Even if the seed, ready dressed, is on the farm, sowing any autumn variety later than mid-February is taking an unjustifiable risk; the seed cost is only about 10 per cent. of the total cost of growing and harvesting a wheat crop, and it would be cheaper to discard the seed than sow it to produce a fore-doomed crop which the County War Agricultural Executive Committee would be fully justified in debarring from acreage payment.

At the end of autumn it is sometimes difficult to decide whether to drill at once or await February. Often the decision to sow in December is taken because of the fear that the land may not be fit to work in February. The position has changed, however, since the introduction of new spring varieties. Several of these have done very well. Atle, in particular, is a wheat whose yield compares very favourably with that of autumn varieties, and it can be sown right to the end of March, or even a little later.

Late Sowings on the Best Soils Only If wheat must be sown late a higher seeding rate, generous manuring, a reasonably good tilth, and, most important of all, protection from birds, are the important points. The chances of success are increased on heavy land by good drainage and, if slopes allow, water furrows should be drawn and shovelled out at the bottom to lead to the ditch. But on all except the best soils late sowing should be avoided. It is far better to make a clean break and change to spring wheat, which can be drilled in good time.

FROST INJURY TO THE STRAW OF WHEAT

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EVIDENCE of damage to wheat caused by the severe frosts of May, 1944, additional to that described by Dr. G. D. H. Bell in the October issue of *Agriculture*, has been obtained in the south-eastern province, but in this part of England the *straw* and not the ears suffered from the direct effects.

Symptoms In late May, specimens of Vilmorin wheat plants were received from crops on the War Agricultural Executive Committee's land near Wye, with the observation that the leaves were dying back from the tips. Removal of the leaf sheaths disclosed that the lowest or the next to lowest internode was watersoaked in appearance and sometimes with a brown discoloration of the tissue; also one or both of the lowest two nodes were brown, the upper nodes being a normal green (see illustration facing p. 361). These symptoms had not previously been seen by us and they did not conform to any described disease. No parasitic insect or fungus could be found to account for them. The roots were healthy.

On May 27 a visit was made to the affected fields, comprising 22½ acres of Vilmorin and 12 acres of Squarehead's Master. In both varieties the brown tips of the leaf blades were a striking feature, but this was rather less marked in Squarehead's Master than in Vilmorin. In the latter variety watersoaked internodes and brown nodes, as described above, were seen to accompany the leaf symptom; in Squarehead's Master the tissue of one or both of the lowest two internodes was partially collapsed and had a white or silvery appearance, but there was no discoloration of the nodes. This variety had lodged in patches in the field. Other wheat crops which were inspected in the same area showed similar symptoms on the stems, but the dying back of the leaf tips was less marked; had the leaf sheaths not been removed, the damage would have escaped notice.

Frosts in Early May Taking into account the absence of a parasitic organism and the widespread distribution of the trouble, it was concluded that the very severe frosts which had occurred in early May were responsible. At Wye, 12, 16 and 18 deg. of frost had been recorded on May 6, 7 and 8 respectively, and it was concluded that the stems close to the ground at the stage of growth then reached were particularly susceptible to frost damage.

Shrivelled Grain Our attention was not again called to any damage to leaves or straw, but from the third week in July complaints were received from parts of Kent and Sussex that ears were poorly filled and that an unusually large proportion of the grain was shrivelled. Associated with this was blackening of the ears. In only a few instances was this condition of the wheat traceable to root rot, but in nearly every case signs of frost damage on the stem were clearly evident.

In our opinion, injury by frost to the cortical tissue to such an extent as to girdle the stem, particularly in association with drought conditions such as existed in 1944, accounts for much of the loss of yield in wheat in south-east England.

Varietal Resistance Reference has already been made to a difference between the symptoms seen on the varieties Vilmorin and Squarehead's Master grown in adjacent fields. An indication of varietal resistance to frost injury was seen just before harvest on a low-lying field at Wye, where part was sown with Jubilégem and part with Holdfast. Symptoms of frost damage were marked on the stems of Jubilégem but were absent on the adjoining Holdfast. An exceptionally high proportion of the grain of Jubilégem was shrivelled, while Holdfast produced a fair sample. Jubilégem had lodged in patches, due to collapse of stem tissue at the base of the straw at positions of earlier frost injury. It was noted that Mildew (*Erysiphe graminis* DC.) was present on both varieties but was more abundant on Jubilégem ; there is, however, no reason to believe that this greatly influenced the marked difference in grain quality.

Blackened Ears Blackening of wheat ears is commonly regarded by the farmer as a disease responsible for poor yield and has been a condition to which our attention has most frequently been called. The discoloration is really due to superficial fungi, particularly *Erysiphe graminis* DC. (Mildew), *Cladosporium herbarum* Fr. and *Alternaria* sp., which are very conspicuous but are considered to be weak parasites or harmless saprophytes. Farmers should realize that so-called blackening of wheat ears, when it occurs in the standing crop, is only a mouldy condition of the chaff and is to be taken as an indication of premature ripening. The cause of this, in its turn, should be looked for at the base of the plant; the present account shows that frost damage in 1944 was a common cause. Where early blackening is seen in any season, particularly here and there in a crop, it would be well to obtain expert advice because other possible causes, never very obvious, are root rots and foot rots affecting the straw, or possibly some soil condition or manurial deficiency.

BARLEY AS A FEED FOR DAIRY COWS

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MOST of the available supplies of oats are required for the production of oatmeal or for making up the rations of working horses, and it is unlikely that there will be much, if any, for allocation under the Rationing Scheme to other classes of live stock. Greater emphasis must therefore be placed on the use of barley in the rations of dairy cattle and other farm animals. Barley not only forms a substantial proportion of the cereal obtainable at present against surrender of ration coupons, but is also the main cereal (other than millers' offals) in the National Cattle Foods : for example, the dairy compounds known as National Cattle Foods No. 1 and No. 1A both contain up to 25 per cent. of barley.

An Old Prejudice No argument is needed to convince the majority of farmers of the suitability of barley for inclusion in dairy rations. Here and there, however, the old prejudice against the use of barley for dairy cows and suckling sows is still encountered. Indeed, some practical men go so far as to refuse to feed any barley at all to cows

in milk, maintaining that it is suitable only for bacon pigs and for fattening sheep and bullocks. In other words, they regard barley as a good fattening food, but one that is unsuitable for the production of milk. In some quarters it is thought that barley tends to dry off the cows, or at least to have an unfavourable influence on milk yield. The writer has even seen it suggested that barley may give rise to musty-flavoured milk, but this is certainly contradicted by the great weight of practical experience. Musty milk could result only from the feeding of musty barley, and never from the use of millable barley such as is now available to the farmer.

Since barley at the present time must form a part of most milk production mixtures and dairy compounds, it is desirable to give a clear answer to the question: does barley adversely affect milk yield? The answer is most emphatically "no," provided it is included in rations correctly balanced for milk production. No scientific foundation for this strange belief can be adduced, and it may be stated with confidence that when barley forms part of a correctly balanced diet, it has a value to the dairy cow and the suckling sow similar to that of the other cereals.

Offsetting Barley's Protein Deficiency It must be kept in mind that barley is essentially a carbohydrate food. It contains about 66 per cent. of carbohydrate (mainly starch), but is deficient in protein from the standpoint of milk production. To make up a satisfactory milk production mixture from barley it is necessary to combine the cereal with a suitable proportion of a food much richer in protein. For example, a mixture of 3 parts by weight of barley with 1 part of high-protein cake (e.g., decorticated groundnut cake) has the correct balance between protein and starch equivalent, and 3½ lb. of this mixture supplies the nutrient requirements for the production of a gallon of average milk. Naturally, if barley is used as the sole milk production food and no steps are taken to rectify its deficiency in protein, it will give poor results and the milk yield of cows receiving such a ration will suffer. In similar circumstances the other cereals would also prove disappointing. Thus the old belief that barley has a detrimental influence on the milk flow of dairy cows has its origin in those times when our knowledge of balanced rations was in its infancy and the need for satisfying both the protein and energy requirements of cows in milk was scarcely realized. It is now fully established that provided barley forms part of a suitably balanced dairy ration, it will have no adverse influence on either the yield or the quality of the milk.

Making Up Mineral Deficiency Barley, however, is not only deficient in protein, but also in minerals, particularly lime and chlorine. Since every gallon of milk removes from the body of the cow about ¼ oz. of lime and ⅛ oz. of chlorine, it is also important, in order to secure the best results from the use of barley, to be certain that the dairy ration as a whole contains an adequate amount of these essential minerals. The oil cake used to make good the protein deficiency of barley cannot be relied on to provide the necessary minerals, but with low to moderate yielders, the roughage that constitutes the maintenance part of the diet usually contains sufficient inorganic matter to protect the animal against mineral deficiencies. With high yielders, however, this is not a sufficient safeguard, and a mineral supplement should be used. This usually takes the form of a mixture of 1 part of ground chalk, 1 part of sterilized feeding bone flour and 2 parts of common salt, 3 lb. of this mixture being incorporated in every 100 lb. of the milk production mixture of cereal and oil cake.

Lightening the Ration As a safeguard against possible digestive disturbances arising from too heavy grain feeding, particularly with cows of more than moderate milk yield, the careful stock-feeder will seek to include in the milk production mixture some additional "cereal" food other than barley. Such an addition has the advantage of lightening the ration and rendering it more digestible. Among such foods purchasable against surrender of cereal coupons may be mentioned bran, dried grains, dried sugar-beet pulp and palm kernel cake.

A Satisfactory Feedingstuff From what has been written, it is clear that barley is a perfectly satisfactory cereal for dairy cows, provided that the total ration contains adequate amounts of protein and minerals. No fears need be felt, therefore, that the introduction of barley into the National Cattle Foods will lower their value for milk production, since the greatest care is taken to ensure that these dairy compounds are correctly balanced in respect both of protein and minerals.

One final point: barley is best fed to dairy cows in the crushed or rolled condition. If ground at all, this should be done as coarsely as possible. Finely ground barley has been shown in American trials to give slightly poorer results in terms of milk yield than the coarsely ground cereal. Moreover, when ground too finely, barley tends to become somewhat pasty in the mouth and consequently to loose palatability. It is inadvisable to pass barley through the hammer mill before feeding it to dairy cows.

GREEN PASTURES

I. LEY FARMING IN BRITAIN

W. A. Stewart with Sir George Stapledon, C.B.E., F.R.S., of Drayton Manor, Stratford-on-Avon, Warwicks, and Major J. A. Keith of Pitmedden, Udny, Aberdeenshire.
(B.B.C. Home Service, October 5, 1944)

THE first discussion in the series, *Green Pastures*, received an encouraging send-off from the Minister of Agriculture. "Grass," said Mr. Hudson in a recorded message, "is of particular importance at the present moment, when we are concentrating more and more on livestock improvement and on a further increase in meat and milk production . . . We have learned to regard grass as a crop"—not as something that just happens. As such it demands a great deal of skill, not only to get a good take, but also to make the most of it afterwards.

Evolution of Ley Farming Mr. Stewart led off with the idea of getting the "ley farming business" into perspective. The history of grassland farming in this country, he said, has been very much a matter of ploughing up for wars and putting back for peace.

Yet there has always been some rotational or ley farming. Leys of two or three years' duration have been part of standard Scottish rotational practice for more than a century, and were common also in Mr. Stewart's own county of Northants before 1800. What then is this ley farming? It is, replied Sir George, to use the ley as the pivotal crop in the rotation—of durations approximately pre-defined. It should be so managed as to produce the maximum of grass nutrients each season, and be at the crest of its potency for sustaining and creating soil fertility at the date due for ploughing out. Only after the depression of the 'seventies was land in England put down to grass on a grand scale. No doubt the first idea was to let it stay down as long as it was reasonably good and plough it up again when it had completely deteriorated. That, however, has nothing remotely to do with ley farming. Major Keith agreed that the ley should be ploughed up while still good and full of fertility. In Aberdeenshire the two-year ley was lengthened to three or four years to control "finger and toe" in turnips. Later, when wild white clover became the vogue, leys remained longer fully productive and, for purely economic reasons, were left down for four or five years. Mr. Stewart observed that the Clifton Park experiments and the use of basic slag were other landmarks in the evolution of ley farming. Sir George thought that phosphates were even more important for the ley than for permanent grass farming, since the ley makes for a cheapening in all-round production. Elliot was very near the truth when he stated: "The cheapest food for stock is grass, the cheapest manure for soil, turf, and the cheapest tiller and drainer of the soil, (plant) roots". In a grassland survey before the war it was estimated that there were in England and Wales at least ten million acres of permanent grassland that could be made to play their part in a reasonable national economy only if the plough was put into them.

" Sacrosanct " Pastures In reply to a question whether any pasture is sacrosanct from the plough, Major Keith replied that some soils are too difficult to crop and reduce to a fine enough state for grass. But Sir George maintained that with modern technique—tractors, discs and drills—all soils, except the too rocky, can be dealt with successfully. As for so-called "super pastures," said to be beyond improvement, he would argue that they have a tremendous fertility which we ought to cash. "It is not a question of leys against permanent pastures but of permanent pastures against the ley farming system—of merely taking the gifts of the gods, or adventuring."

Major Keith retorted that this is an economic question. "At war prices it will produce more cash if you plough the pastures up and take a few crops before you sow them down again—but not in normal times." This view seemed to Mr. Stewart to accord with that of the Midland grazier.

Ley Farming in the Drier Districts The discussion was then switched to ley farming in the drier districts. Major Keith, who farms extensively in Norfolk as well as in Aberdeenshire, said that the trouble in Norfolk is the drying up of the land. The crux of this matter is not the establishment or management of the ley but the turning of it to profitable account. The pasture dries up in July and August, even in September, and complicates stocking, tending to make it comparatively unprofitable. It is not so much a question of a lighter rainfall than in Aberdeenshire, as of drying winds and higher temperatures aggravated by a non-retentive subsoil. Mr. Stewart has experienced the same trouble on the ligher soils of Northants.

Sir George's answer to this was—leys of different sorts. Whatever the physical limitations, the problem is to maintain the leys flush and green throughout the dry season. This means, in addition to different kinds of leys, some with cocksfoot and timothy as well as ryegrass, more fencing and water facilities, coupled with such management as will give what is wanted at the prescribed time ; under dry conditions leys need longer resting than grazing periods. Cocksfoot is most palatable and most nutritious when actively growing ; it is the king of aftermaths, and a leafy aftermath at that. By silage cuts and early hay cuts one gets a range of cocksfoot aftermaths.

Major Keith agreed. A neighbour of his in Norfolk had very good results this summer with a lucerne and cocksfoot ley (whether grazed or mown was not stated) while, at the same time on black fenland, ryegrass leys were almost a complete failure. "What it really amounts to," said Mr. Stewart, "is that on the lighter soils you should have three fields—one being grazed and two resting." "Yes, and more than that," responded Sir George, "I mean fields in different leys and each field in sub-paddocks." Ryegrass is valuable in spring and in the back-end ; cocksfoot also in spring and, if properly managed, in June, July and August.

The difficulty with cocksfoot, in Major Keith's experience, is that as soon as it gets strong and "rusty" at the end of the year stock simply will not look at it. In his view the pasture situation has not yet been investigated widely enough, and that is why most people have been content with standard mixtures containing chiefly ryegrass and wild white clover.

Duration of Leys On the question of the length of ley, Sir George said that the hay ley must be ploughed when it has the maximum penetration of leguminous root—after one year with broad red clover, two years with late-flowering red, and longer for sainfoin and lucerne. The grazing ley should be ploughed before there is any semblance of a mat or a return to agrostis, and while still full of white clover. Major Keith thought duration must depend on the class of stock and the size of field. For dairy stock there must be grass near the central buildings. Consequently it will be left down longer. For sheep the land nearest the buildings would be cultivated and the outlying fields grazed. Small fields would be left longer in grass than large fields.

If there is plenty of wild white clover in the sward, leys in Aberdeenshire will lie up for five or six years without any apparent deterioration ; three years, however, is sufficient to maintain fertility. All of which, Sir George thought, emphasizes what a scientific business and how flexible ley farming really is. Mr. Stewart mentioned that in the Midlands before the war, the tendency on heavy land farms was to have one-third in tillage crops and two-thirds in leys down for six or seven years. It takes longer on heavy land to get the pasture dense enough to carry stock in all weathers. For rapid formation of pasture, Sir George recommended seeding without a cover crop and grazing from scratch.

Most Leys are Dual-purpose On the question whether there should be separate hay and grazing leys or dual-purpose ones, Sir George said that most leys are in fact dual-purpose, with hay usually taken in the first year—an inevitable clash between expediency and maximum efficiency. A clear distinction between hay and grazing leys he regarded as a fundamental tenet of modern ley husbandry.

Major Keith thought the taking of hay in the first year was customary because it was easier to cut and cure than the leafier crops got in later years.

He agreed that for a specially good pasture one should graze the first year and so establish wild white clover sooner. Best of all, according to Sir George, would be a two-year hay ley based on ryegrass and late-flowering red clover and a four-year grazing ley. Major Keith admitted that it might work but he feared Sir George's farm would be like a jig-saw puzzle and very difficult to manage.

Farming without the Muck Cart The next question concerned the ley in post-war farming. Major Keith thought that it would be the only way to maintain land under cultivation cheaply and that it could be practised in any part of the country if the summer gap in the drier districts could be filled. On the farm, as distinct from the market garden, muck carting on the old scale was becoming impossible. Muck should only be a subsidiary operation to profitable milk or beef production. To keep cattle purely to make manure is sheer foolishness. "Grand," said Sir George, "the ley makes it possible to farm without the muck cart. Ley is muck and fodder at the same time." "But," he added, "we've got to do something with the mountains of straw, and it is surprising the extent to which a virgin ley can grow through and absorb straw." Major Keith objected that spreading straw on the surface interfered with hay-making and with autumn cleaning. He had found the paper mill to be the best absorbent.

Mr. Stewart, however, prefers to utilize the straw on the farm in one way or another.

Up Horn, Up Corn As to cereal production after the war, Sir George contended that we should be unable to produce all the milk and meat we want unless we also grow corn, for in most districts proper ley farming is unthinkable without corn. So is our countryside: "Without beauty all zest goes out of farming and all is lost". "Agreed," said Major Keith, "but my butcher and baker want cash . . . what will the economists say ?" Sir George answered this question by asking another: "What does the nation intend to allow them to say ?" In his view there is such a thing as national self-respect and rural self-respect, and it is for the economists to make the two economic.

So much then for the possibilities of ley farming. What about the snags ? "Fencing and water supplies," said Major Keith, "both very costly." "And shortage of cottages," added Sir George. Mr. Stewart said that ley farming calls for a higher class of labour—dual-purpose men, who combine mechanical efficiency with stock sense.

Variation of Grass Mixtures The final question was: have temporary leys got everything in them that the animal needs ? Instances were quoted of animals leaving lush pastures for rough grass, strips of chicory and other herbs, and even picking up straw from the byre gutter as they came in for milking. It was generally agreed that knowledge about an animal's full nutritional requirements is still far from complete and, further, that grass mixtures must be varied and adjusted to suit environmental conditions and the purpose in view. Above all, grass must be regarded not as an end in itself but as a medium for satisfying the needs of all classes of farm animals and making farming pay.

RED CLOVER FOR SEED

DAVID ALSTON
Sudbury, Suffolk

RED clover has for many years been one of the most important agricultural seed crops grown in this country. In peace time enough seed was produced in some seasons to provide fully for home requirements and a substantial quantity for export. Farmers in the eastern counties have been in the habit of saving seed of red clover after a hay crop has been taken in early June; this is often a useful and profitable by-product from pure red clover layers sown for hay. Although small quantities of seed have been saved in the West of England and Wales, the bulk of the crop is produced in East Anglia, where a low rainfall restricts vegetative growth and thus promotes seed formation and early ripening. It is, of course, quite hopeless to expect to grow clover seed on an acid soil, as it would be almost impossible to get a plant to take or to stand. Further, land which burns in a hot period is unsuitable, as, except in a very wet season, clover rarely makes a good second growth on this type of soil.

To avoid clover sickness, red clover is not usually grown on the same land more than once in eight years. It is also necessary to leave red clover out of any hay mixtures sown in intervening years on land which is subsequently to be used for red clover seed production.

Cultivation The seed is drilled or broadcast in the spring, under a cover crop of any white straw at the rate of 10–14 lb. per acre. Very often the seed is broadcast behind the corn drill, so that both corn and clover seed are harrowed in together.

With seed sown under a cover crop of spring corn, it is essential to consolidate the soil with a heavy roll after sowing if a satisfactory plant is to be obtained. The necessity for this is demonstrated by the fact that while there is frequently a good plant on the headland, the rest of the field is a complete failure.

One difficulty of growing red clover is that early sowing in a wet season causes excessive growth and complicates the harvesting of the corn crop; while late sowing in a dry season can mean a complete plant failure. Personally, I favour broadcasting early sowings and drilling the later ones. I have never had any difficulty with excessive clover growth in a winter-sown crop.

Red clover does not as a rule need any artificial manuring, but when difficulty is experienced in getting a plant the addition of phosphates is a great help at the time of seeding. Sometimes, under normal conditions, this is applied after the harvesting of the cover crop. I have always considered that the excessive use of sulphate of ammonia on the cover crop is harmful to the red clover layer. A point to be remembered is that the use of sulphuric acid for weed control will kill red clover. If there is any likelihood of this being used, the clover must not be sown until after spraying.

Red clover is allowed to run straight up for hay in the spring and is cut for hay in the first two weeks of June. I should say that in an average season early cutting of the hay crop gives the best chance of a good yield of seed.

Harvesting for Seed After cutting the hay, it is an advantage to the even growth of the crop if there are a few showers to start all the plants into growth at the same time. After this, little rain is

necessary to bring the crop to maturity in late September or early October. It is essential that the crop should be properly ripened at the time of cutting, as the seed will not make on the stem. The crop is ready to cut when the majority of full seed heads are brown and crisp, and the firm, matured seeds rub out easily in the hand. In the eastern counties the merchant usually looks for a fair amount of purple-coloured seeds in the sample. These denote maturity without being weathered.

Cutting is done by sail reaper, mower, or binder. For the past few years I have used an 8-ft. power binder. The crop is not tied, and if free from green growth is thrown out in heaps. If there is much green growth, the trip lever is removed so that the crop is left in a neat swath.

The crop should be carted as soon as it is safe to stack. If the crop is on the green side, it is an advantage to keep the stack narrow and to interpose layers of straw to prevent heating.

Careful Hulling Hulling is best done in a dry, frosty period, when the seed rubs out more easily. When a seed crop is stacked after harvest and left for any length of time the seed usually becomes very dry, and during hulling is liable to break unless great care is taken by the man in charge of the machine. It is essential to ensure that the cob is not allowed to pass into the beaters too slowly; it forms a natural cushion for the hulled seed between the beaters and the metal cone. The drawn seed must also be allowed to pass out of the huller as quickly as possible; if it is allowed to remain in the machine too long much of it will be crushed and broken. Another point which is worth watching is the cleanliness of the sieves. If the top sieve is blocked with cob the hulled seed will ride over it and will be returned automatically to the drawing drum and passed through without any cob to protect it. Once clover seed has been broken up by the huller, it is very difficult to get a good purity, as chipped and broken seed count as inert matter in the purity analysis. On the market a much lower price has to be taken for samples damaged in this way.

After the seed comes off the huller I always like to put it over the blower to get rid of the light seeds and so have a much more presentable sample.

In the last few years some local farmers have satisfactorily harvested their red clover by combine, but the crop has to be left until it is dead ripe. I feel, however, that this is taking a great risk, as a heavy rain or strong wind would knock out the seed from the heads.

Pure Seed in West Suffolk During the last three years some very comprehensive local strain trials of broad red clover have been carried out by Seed Growers' Associations in conjunction with the National Institute of Agricultural Botany. The best stocks of these are being grown on by local Seed Growers' Associations under careful supervision. In West Suffolk we have at the present time three stocks of red clover which are being grown in this way. Although the failure of layers last year will make little, if any, of this certified seed available in 1945, our Seed Growers' Association is hoping to have a certain amount of seed for distribution in 1946. By these means we try to keep the standard of West Suffolk seed very high, and to prevent our growers producing seed from inferior strains of foreign origin.

It is most important for growers to make sure that the stock seed they use is genuine English from a stock of proved quality.

CLOVER ROT

W. A. R. Dillon Weston, M.A., Ph.D.

School of Agriculture, Cambridge

WHEN red clover is grown too frequently on the same land the crop may fail, and the field become "clover sick". This "sickness" is usually due to the contamination of the soil with the Clover Rot fungus, *Sclerotinia Trifoliorum*, but in some cases it may be caused by a parasitic eelworm in the soil. This note deals only with the fungus disease.

Clover Rot usually begins in the late autumn, but attacks may occur throughout the winter and early spring. The disease is most severe during a mild winter following a wet autumn, and in damp, muggy weather it spreads rapidly. The plants turn brown and rot, leaving bare patches on which weeds grow. Dry, frosty conditions, however, check the rot, and spells of such weather may lead to a partial crop recovery.

Production of Resting Bodies The fungus forms resting bodies (sclerotia) on the dead or dying plants; these are composed of hard, compact masses of fungus mycelium, at first white and finally black. Some are as large as a pea, others as small as a pin's head. It is these bodies which contaminate the soil and are responsible for subsequent attacks of Clover Rot. During the summer they remain dormant, but in early autumn those near the surface germinate and give rise to flesh-coloured, saucer-shaped, stalked bodies called apothecia, and it is these which produce the spores causing the disease.

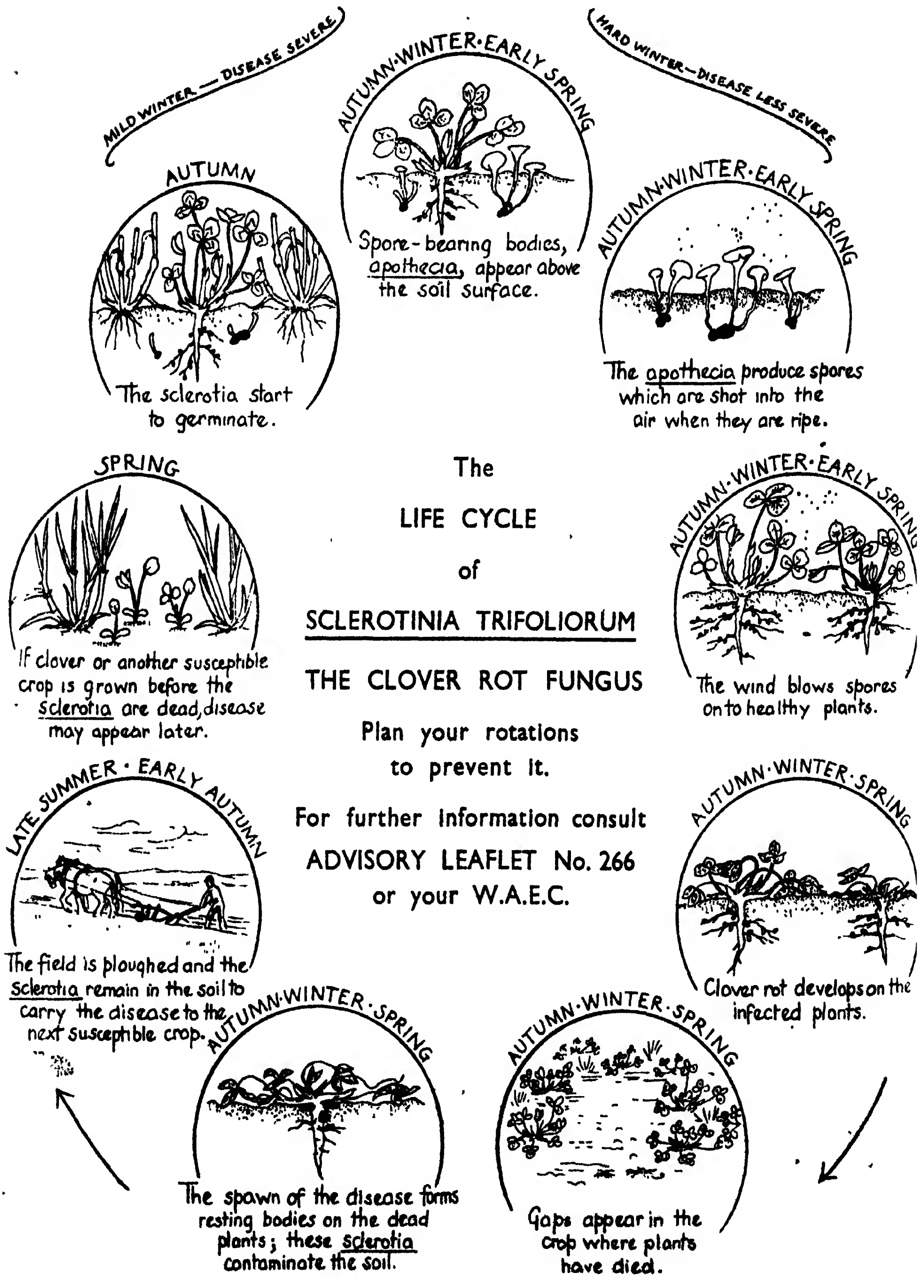
Other sclerotia, more deeply situated in the soil, remain dormant for one or more years, but when cultivations bring them near the surface they too may germinate and produce spores which are carried by the wind to nearby plants or neighbouring fields.

Varying Susceptibility of Plants Clover and allied plants vary considerably in their susceptibility to the disease. Common or broad red clover suffers more frequently and severely than any other variety, but late-flowering red clover (single-cut cowgrass) is also very susceptible. Trefoil, although often affected, usually withstands the disease better, and the attack is generally much less intense. Alsike and white clover are susceptible but usually to a less degree than trefoil. Sainfoin and lucerne are sometimes attacked during their first year, but they show increasing resistance after one season's growth, and failures are infrequent. Vetches are rarely affected and peas are resistant.

Bean Rot Field beans, however, suffer from Bean Rot, a similar disease due to a varietal form of the Clover Rot fungus. The organism affects the plant at or about soil level and progresses upwards for a short distance into the stem and downwards into the root, and the attacked plants ultimately wilt and die. These symptoms are usually noted about mid-March or early April, but affected plants continue to die until harvest. If the disease is in an advanced stage, the sclerotia will be found attached to the root or, in some cases, enclosed inside the stem. As with clover, they contaminate the soil and serve to carry over the disease from one bean crop to another.

Control The remedy for clover and bean "sickness" is to starve the fungus from the soil by growing only those crops that are resistant or less susceptible to the disease. On land where Clover Rot has

been troublesome, an interval of at least eight years should be allowed before common red clover and late-flowering red clover are taken again. During this period, sainfoin or lucerne can be sown if there is sufficient chalk in the soil, or alsike or white clover may be substituted, either alone or with Italian ryegrass. Beans should not be grown, but peas may be taken since they are not attacked. When a return is made to red clover, however, the seed should be sown with Italian ryegrass or with alsike and trefoil.



A FARMER'S ESTIMATE OF TUNSTALL

ARTHUR BARKER

Ipswich

OF all the factors which govern plant growth, the available supply of moisture in the soil is the most important. While, however, there may be sufficient moisture in the ground just below the surface, certain crops will not flourish because of a deficiency of some essential element in the soil. The Tunstall (Suffolk) Light Land Experimental Farm has furnished many examples of this in recent years. This centre was started in 1925 by the Education Committee of the East Suffolk County Council. Its object was to ascertain what could be done with poor light land which at that time was fast becoming derelict. From the beginning the Farm has been fortunate in its management, placed as it was under the direction of Mr. A. W. Oldershaw, then Agricultural Organizer for East Suffolk, and assisted by his very able foreman, Mr. Thurston. Mr. Oldershaw has previously given the results of various experiments in this JOURNAL,* but to show how the problems of soil deficiency and drought are interrelated, I should like to refer to them again.

It has been known from Roman times that lime has a beneficial effect on the growth of crops, and agricultural scientists can tell us how much to apply to remedy the deficiency on various soils. The Tunstall experiments, however, have shown that there was still a lot to learn on this important subject.

Chalked and Unchalked Plots Most of us who have farmed in East Anglia used to think that crop failure on very light land was due chiefly to drought. The tests at Tunstall have proved that this is by no means the main cause of poor crops on such land. One field at Tunstall, known as the Heath Walk, has illustrated this consistently for 19 years. This rectangular field of about 9 acres was divided lengthways into two equal parts, one of which was dressed with 5 tons of chalk per acre in the winter of 1925–26, the other half being left unchalked. Leaving a space at each end for other experiments, the field was sub-divided into 8 half-acre plots. This enabled a four-course rotation to be conducted in duplicate, the rotation being: lupins or peas—rye—half sugar beet, half potatoes—oats or barley. Each year half of these crops could be seen growing on the chalked side of the field, and half on the unchalked side. This proved to be an excellent plan, for at the annual inspection the differences in the crops could be noted at a glance from the middle of the field. Artificial manures were applied according to the needs of the various crops; and identical treatment in all respects was given to the chalked and unchalked portions of the plot. The results, year by year, were amazing.

Every year on the unchalked side of the plots, sugar beet and peas were a complete failure, and barley a ragged, unprofitable crop. On the chalked half these crops gave quite good yields. It is a remarkable object lesson which can be seen every year at Tunstall—nothing but spurrey and sorrel growing where there should be sugar beet or peas, whilst on the chalked half similar crops are in vigorous growth. Oats produced good crops, both on the chalked and unchalked areas. So did potatoes, but the latter have always yielded most where chalk had been applied. It is significant

* A. W. OLDERSHAW and H. V. GARNER: "Tunstall Experiments with Carbonate of Lime". (1942), **49**, 37.
A. W. OLDERSHAW: "Lupins as a Light-land Crop". (1941), **48**, 164.
A. W. OLDERSHAW: "Farming Light Land in War Time". (1941), **47**, 238.

that in the severe drought of 1929, potatoes gave 6 tons per acre more on the chalked than on the unchalked plots. Rye was heavier on the chalked land. Lupins succeeded on chalked and unchalked land alike. These results showed the value of oats, rye, potatoes and lupins as suitable crops for acid land and during the time chalk is being worked into the soil. Where chalk had been applied, there was, in a period of ten years, increased produce to the value of £64 7s. 6d. per acre over the same area on unchalked land—and this in return for an expenditure of 50s. per acre for chalk.

Other experiments were carried out at Tunstall in growing carrots, parsnips and lucerne; carrots on one occasion yielded 33 tons per acre on the chalked land. Lucerne on chalked land gave an annual average yield of 3 tons of hay per acre for seven years in succession. Then it was ploughed out and the land sown with sugar beet, which produced the enormous crop of 20 tons per acre.

Chalk and Resistance to Drought When it is realized that the land from which these yields were obtained was, previous to the experiments, regarded as almost worthless blowing sand, and that good crops were obtained on the chalked plots over a number of years although often marked by early summer drought, it is evident that it is not so much lack of moisture which is responsible for crop failure on land of this description as lack of lime. This and the practical experience of farmers elsewhere in East Englia prove that so-called poor light land with scientific improvement and good practical management can not only be made productive but will withstand drought much better than some mixed soils of a gravel nature. Underlying these very light soils there is often many feet of damp sand, from which the moisture constantly rises to the surface in hot, dry weather, especially where it is possible to keep the land loose by frequent hoeings. Another source of moisture is the dew which collects on the leaves of crops in luxuriant growth. This is encouraged by the presence of chalk.

On the Tunstall soil it has been found that when the chalk has had time to work in, red and white clover will flourish on fields where formerly they failed. The soil in the surrounding district responds equally to chalking.

These benefits are applicable not only to tillage crops, but also when laying down temporary and permanent pastures.

There have been some indications at this Centre that lupins do not like too much lime in the soil. A new variety of sweet lupins with a yellow flower has been grown at Tunstall for the past three years, and has provided sufficient seed to enable extensive tests of its value both for fodder and seed to be made in Suffolk this season.

It is interesting to note that the seed of sweet yellow lupin contains about 40 per cent. of protein, compared with 28 per cent. in blue lupin and 22–25 per cent. in beans and peas.

Chalk better than Sugar-beet Sludge Sugar-beet sludge has been used as a source of lime at the Centre with good results, but chalk is the better material. The latter spread on the surface is gradually disintegrated by the weather and soil cultivations, and supplies enough lime annually without undue loss by drainage into the subsoil. Where 5 tons of chalk per acre were spread on one half of the rotation plots at Tunstall, the results after 19 years appear to be as good as ever. The character of the chalked soil has changed noticeably; it is darker in colour and less liable to blow.

Replicated Plots The small replicated plots here were started in 1932 at the suggestion of Sir E. John Russell, and are cultivated by the Centre for the Rothamsted Experimental Station under the supervision of Mr. H. V. Garner. These are of interest, especially the plots where the effects of various quantities of chalk, from 1 ton up to 5 tons per acre, are being compared with unchalked plots. Here too the wonderful effects of chalk are very noticeable. As far as the experiments have gone the results suggest that 5 tons per acre is the most economic dressing on this sandy soil. It must be pointed out, however, that in some parts of the country lime deficiency is so serious that as much as 10 tons of chalk per acre are required to rectify it. It is therefore advisable in all cases where lime deficiency in the soil is suspected to apply to the County Agricultural Organizer to have it tested and follow his advice.

Chalk and Sulphate of Ammonia At one time it was thought that sulphate of ammonia was of no value on light and gravel soils, but where the land has first been chalked at Tunstall, it has given quite good results with potatoes. Mr. Oldershaw believes that in the dry climate of East Anglia the best results are obtained by applying fertilizers early. He claims that much more is rendered ineffective by not being washed into the ground than is lost by drainage into the subsoil after heavy rain. This is particularly so with rye, which, when sown at Tunstall in September and dressed with 3 cwt. of nitrates in February, has given excellent yields. Early sowing of the fertilizers stimulates root development and vigorous growth, with consequent resistance to drought. One year, owing to war conditions, the nitrates could not be sown until March, and the results were not so good. Tens of thousands of acres of light land in East Anglia have been chalked as a result of the experiments at Tunstall. Mr. Thurston, the foreman, remembers neighbouring farms before the experiments were started. He pointed out to me fields which years ago were considered to be of little value for arable farming, which to-day are producing good crops as a direct result of putting into practice the knowledge these remarkable rotation tests have brought to light.

During the years of depression after the last war much poor light land in Suffolk, and even good land, fell in value to such a low figure that several farms were purchased by the Forestry Commission for afforestation. To-day, now the results of chalking and the lime subsidy are available, these farms could be cultivated profitably. There are many districts, however, in these blowing sand areas where shelter belts of Austrian pines would be an advantage both for crops and stock.

Water Supply Supplements Benefit of Chalking Whilst fully appreciating the good results of chalking light land, Mr. Oldershaw is of the opinion that in most years the yields would be even better if the rainfall were higher. Even such a deep-rooting plant as lucerne could do with more moisture. Saved for hay at Tunstall, the first crops of lucerne are usually good, but when the ground loses the shade of the crop during hot, dry weather it soon dries out and the second crop may be disappointing. In a spring-fed stream in Suffolk I have seen water running to waste past fields on which potatoes were failing for lack of sufficient moisture. In British Columbia the water from such a stream would be drawn to the highest point of the surrounding land and used for irrigation. In most parts of Suffolk there is plenty of water in the chalk at a depth of 200–300 ft.

Another source of supply would be to construct gravity-filled reservoirs beside streams which flood in winter and to pump out the water in summer as required.

Land deficient in lime exists all over Great Britain—for example, those large areas, including heathland, on which little grows except heather and bracken. One blessing is that we have plenty of material to make good the shortage. It has been estimated that there are chalk deposits totalling a thousand million tons in the Gipping Valley of Suffolk alone.

CALF-REARING ON A CUMBERLAND FARM

C. K. THOMPSON, B.Sc., A.R.I.C.

Cumberland War Agricultural Executive Committee

IT was not in response to a Government appeal that the late Mr. J. R. Sharp instructed his cowman to use less milk for calf feeding, but to meet the demand from the manageress of his Whitehaven dairy for more milk to supply an increasing number of customers. This was some years ago, when there were not quite so many milk producers in south-west Cumberland as there are to-day. The developing trade had, of course, to be satisfied, and it was more economical to supply milk from his own herd than to buy it in from other farmers.

At this time Mr. Sharp was farming 338 acres in the Drigg and Carleton district on the coast of south-west Cumberland. This was composed of 198 acres of permanent grass, 57 acres of tillage, and 83 acres of rough grazing (mainly sand dunes). But in 1941 his activities with the National Farmers' Union and the War Agricultural Executive Committee necessitated a move to a smaller farm (Maudsyke) comprising 104 acres, of which 30 acres were tillage.

The soil in the Drigg area is mainly a medium sand and not highly fertile. Also, the farms are not easy to manage since the fields are widely scattered; there are hardly two adjacent fields belonging to the same farm. The proximity of the sea and the Cumbrian Hills to the east make the climate rather milder than might be expected, and this may have been of some assistance to Mr. Sharp's livestock programme. The severe winters of 1941 and 1942 tested it without adverse results.

Mr. Sharp started with a commercial Dairy Shorthorn herd, but over twenty years ago he began using a British Friesian bull and has gradually built up a Friesian herd; many of the animals are now in the Supplementary Register. Additions to his herd have been made by the purchase of pedigree Friesians.

Dry Food at about Four Days Old

Together with Ernest Matterson, his cowman, Mr. Sharp evolved a method of calf-rearing which, although drastic, has proved very successful.

For the first day of its life the heifer calf receives beastings, and for the next three days a quart of milk and a pint of warm water, morning and evening. When the calf is about four days old a little dry food is placed in the bucket after the milk and water have been consumed; this is offered

at each meal until the calf starts to eat. From this time the milk is gradually diluted with warm water until at the end of a fortnight the milk has been totally replaced by warm water and half a pound of dry food. The water is fed first and the cake placed in the trough or bucket immediately after the calf has finished drinking.

For the third and fourth weeks of its life the calf is given about ½ lb. of dry food, warm water, and enough hay to supply its needs without waste—about 1 lb. a day. During the following month the dry food is increased to 1½ lb. plus 1 lb. of roots.

Of course, some calves take to the dry food much more quickly than others, and some have to be given rather more milk. Mr. Matterson adjusts the system to suit the needs of each calf.

Before the war the dry food mixture consisted of (*parts by weight*): Bran 1; Flaked maize 1; Calf cake 1; Linseed cake ½. Since the war this mixture has varied considerably, but at the present time it is (*parts by weight*): Crushed oats 3; Bran 1; Linseed 1; Calf cake 1.

One of the essential points in this system of feeding is that the calves are fed according to individual need. It depends on the space available whether a calf is tied up at a day old or later in life, but it is put in a stall never later than seven days from birth. All the calves are kept separately from each other until they commence eating dry food. Then they are grouped in pens according to age.

The condition of the calves at the end of the milk period is, of course, not that of calves fed with greater quantities of milk, but they always have a good bloom and they certainly go ahead as they grow older. During the past eight years only one calf has died from feeding trouble, and that one had inadvertently obtained more than its share.

Milk Recording Practised Shortly before his death in 1943, Mr. Sharp started milk recording, and his son has continued with it. All the cows raised by the above system have given very satisfactory results. Some of the records are as follows:

	Date of Birth	Milk Yield	Butter-fat (*per cent*)
Maudsyke Judy (A.S.R.)	Oct 27, 1936	8,778 lb 272 days 4th calf 12,504¾ lb. 352 ,, 5th ,,	3.51
Maudsyke Sheila ..	Dec. 11, 1936	11,638¾ lb. 356 ,, 4th ,,	3.34
Maud (a red and white crossbred)	Nov. 23, 1936	11,641 lb. 357 ,, 4th ,, 10,179½ lb. 319 ,, 5th ,,	3.10 —
Maudsyke Mabel (A.S.R.)	March 11, 1937	6,488 lb. 257 ,, 3rd ,, 10,085½ lb. 373 ,, 4th ,, Still giving 2 gallons	3.79 —
Maudsyke Janette (A.S.R.)	Aug. 10, 1937	7,589 lb. 269 ,, 4th ,, 4,105¾ lb. 133 ,, 5th ,, Still giving 27 lb.	3.00 —
Maudsyke Jeanette (A.S.R.)	April 8, 1941	4,452¼ lb. 228 ,, 1st ,, 4,657½ lb. 223 ,, 2nd ,, Still giving 7 lb.	3.44 —
Cherry	March 2, 1941	7,854¼ lb. 362 ,, 1st ,,	3.73
Nanette	March 14, 1941	10,015½ lb. 351 ,, 2nd ,,	3.04

CALF-REARING ON A CUMBERLAND FARM

The formation of a Young Farmers' Club at Drigg in 1943 and the keeping of a calf by John Bowes on Mr. Sharp's farm has resulted in a detailed account being kept. A summary of the record is as follows:

Nanette II — born October, 1943.

	Cost per month £ s. d.	£ s. d.
October, 1943		
New milk 9 gallons at 2/3	1 0 3	
Crushed oats 3 pt. / Bran 1 pt. / Linseed 1 pt. / Calf cakelets 1 pt.	2 7	
Meadow hay for last 14 days	1 0	
		1 3 10
November, 1943		
Dry food (mixture as above) 41 lb.	5 2	
Meadow hay 1½ lb. day	2 11	
Roots	6	
		8 7
December, 1943		
Dry food 1½ lb. a day 46½ lb.	5 10	
Meadow hay 2 lb. a day 61 lb.	4 4	
Roots 2 lb. a day 61 lb.	1 0	
		11 2
January, February, March, April, 1944		
Dry food 1¾ lb. a day 212¼ lb.	1 6 6	
Meadow hay 2½ lb. a day 300½ lb.	1 1 6	
Roots 2½ lb. a day 300½ lb.	5 0	
		2 13 0
May, 1944		
Rearing cake ½ lb. a day 15½ lb. (and out to grass) ..		1 11
June and July, 1944		
Rearing cake ½ lb a day 30 lb.		3 9
Total Cost ..		£5 2 3

WAR-TIME FARMING IN WILTSHIRE

W. T. Price, M.C.

Wiltshire War Agricultural Executive Committee

Wiltshire is a typical rural county and almost entirely agricultural. The area of its agricultural land is approximately 750,000 acres, but of this some 130,000 acres, mainly the chalk downs, are scheduled as rough grazing. At one time, Wiltshire's farming was predominantly corn-growing with folded sheep, but from just before the first world war milk production, which had hitherto been concentrated in the north-west, spread over the whole county. A further extension took place after 1918, with the watering and fencing of much of the downland and the introduction of the system of open-air milk production by the portable milking bail designed by Mr. A. J. Hosier. Thus Wiltshire to-day is one of the six largest milk-producing counties in the country.

The geology of Wiltshire is relatively simple. The soils of the south and east (well over half the county) are derived from the chalk formations. The other main formations are the clays (Oxford, Kimmeridge and London), the sands (upper and lower greensand) and the oolitic limestones, which occupy the north-western corner and are actually an extension of the

Cotswolds. Rainfall varies from about 28 inches in the extreme south-east to well over 50 inches in the west, and, generally speaking, permits the growing of most agricultural crops.

The main areas still under grass are concentrated on the heavy clay soils, but these are likely to be brought under the plough as part of the Four Year Plan.

The average size of Wiltshire holdings is larger than that in any other county; five hundred of the holdings are over 300 acres, and a typical chalk farm ranges from 600 to 800 acres. This fact has permitted mechanization to be developed to a high degree. This does not imply that small holdings have been neglected; the County Council alone own over 15,000 acres devoted to small holdings.

Organization for the Food Production Campaign Agricultural education was well established before the outbreak of war, and has formed a basis for the organization of the food production campaign; many of the members serving on the County Council Agricultural Committee took office on the War Agricultural Executive Committee, and the Agricultural Organizer and his staff were also seconded immediately on the outbreak of hostilities. For the purpose of administration, the War Agricultural Executive Committee has divided the county into six districts, each with its own sub-committee and staff.

This technical aspect has been of the greatest assistance in implementing the policy of the Ministry of Agriculture, and the work was further coordinated by the setting up of the Technical Development Sub-committee. During the six months ended March, 1944, this Committee has organized 335 demonstrations, lectures and technical meetings, with a total attendance of over 14,000.

The county has followed closely the policy of the Ministry by concentrating on milk and bread corn. This has involved considerable reorganization, inasmuch as pre-war milk production in the county relied largely on imported feedingstuffs. As far as possible, however, every farm has now been made self-supporting in this respect. The position for the harvest in 1943 as compared with that of 1939 was that:

(i) The acreage of bread-corn (wheat, barley and rye) has been increased two-and-half times.

(ii) The potato acreage has been increased sixfold.

(iii) Flax has again been introduced, and the acreage in the county is sufficient to maintain the new factory erected at Devizes. Last year the in-take was 6,000 tons of flax.

(iv) The area devoted to vegetables has been extended from 790 to 2,000 acres, while glasshouse production of salad crops and tomatoes has been increased by 50 per cent.

(v) At the same time milk production has been fully maintained. This in itself is a large industry, producing several million gallons a month, and has involved the maintenance of a large number of cows and heifers. It is interesting to note that for the year ended September, 1943, the average *sales* of milk from 100,000 cows and heifers was 570 gallons per head. Other cattle have been increased by approximately 8 per cent.

There has, of course, been a large reduction in the number of pigs and poultry.

The acreage of sugar beet grown in the county is not large because of the distance from the factories, but it has been demonstrated that the soil and climate of Wiltshire can grow a heavy yield of sugar per acre.

The 1943 harvest was an all-time record for the county, and this year it is hoped to exceed that, as there are a further 30,000 acres under the plough. The record was achieved because although the area of land devoted to farming is less than in earlier days, the average yields of all crops have been materially increased by the raising of the general level of farming, by the introduction of improved methods of cultivation, the scientific use of fertilizers and the use of improved strains of crops.

At the time of writing it is too early to assess accurately what the results of the 1944 harvest will be. The arable area has been increased, and despite an expected slight fall in the wheat acreage, the total area under cereal crops is approximately the same as in 1943. Early estimates of yields were only moderate. Rains following an unusually dry winter and spring came in time to make a marked improvement, particularly to the barleys. Yields will no doubt be variable, but the threshing returns so far indicate a much better prospect than was at one time thought possible.

The Committee gives all possible assistance to the smaller farmers in the county by the usual contract work for cultivations, harvest, etc., and the Machinery Department operates some 175 tractors. Spraying of potato haulm and weeds in corn, besides preventive spraying against Potato Blight, is undertaken by two local firms, who act as agents for the Committee and operate mainly with their own equipment.

One of the main problems is, of course, the supply of labour, and the greatest use is made of prisoners of war, both working in mobile gangs and as individuals. In this latter category some five hundred have been placed as resident workers on farms, and this appears to give the best output. For the harvest last year supplementary labour, totalling three thousand workers, came mainly from volunteer harvest camps, of which there were eighty-six in Wiltshire. This year there were seventy camps, with 2,500 workers.

Drainage does not present any special problem. Ditching is the main activity. Up to March 31, 1944, 1,367 ditching schemes have been completed, representing over 750 miles of ditching; also 150 water supplies have been installed on farms. Emphasis has been laid on the need for adequate and well-planned water furrows on those heavy lands that are sown with winter corn. There is an increasing demand for under-drainage (mainly mole) and for the installation of farm water supplies.

Land Reclamation There were no large tracts of derelict land in Wiltshire but there were scattered areas composed mainly of commons, and gorse and forest land. Although the policy of the Committee has been to farm the minimum amount itself, preferring to let as much land as possible to good tenants, the Committee has retained the most difficult areas and now has in hand only some 3,500 acres.

The procedure in connexion with land to be reclaimed has been first to discover, if possible, the cause of the land being derelict and to identify the factors limiting the growing of good crops. After the land has been cleared, ploughing with large ploughs such as Prairie Busters has become standard practice for the rougher land, stress being laid on the importance of good work in the initial ploughing. Thereafter cultivation operations are very similar to those on normal land.

Some of the reclamation schemes have been concerned with marginal land—in the main, the light, black, puffy soils overlying the chalk of the downlands. The difficulty on this class of soil is consolidation. In the first year consolidation may be carried out effectively from an old sward by a succession of operations following close behind the plough. In the second year disc-harrowing instead of ploughing has produced useful results, but this soil can be consolidated only when it is wet, and it has been found that that is the time to do the cultivations.

For the most part, the limiting factor both in derelict and marginal land has been lack of potash. Cases have been met where land was ploughed up in the last war but which failed completely to grow any crops whatsoever; it was then allowed to fall back to grass. These lands have been ploughed up again during this war, and after application of sufficient potassic fertilizer (for a potash-priority crop) they have given very good results.

In one case some 30 acres of very foul and almost derelict arable sandy soil were successfully cleaned by ploughing in the top five inches containing onion and string couch grasses, and covering these with not less than ten inches of subsoil. A deep digger plough drawn by a wheel tractor skimmed off the surface, turning this top soil into the 15-inch wide and 18-inch deep furrow made by a Prairie Buster plough drawn by a crawler tractor. The tracks consolidated the turned-in top soil and materially assisted in burying the weeds. Good crops of roots and potatoes (an 8-ton crop of earlies to the acre) were grown in the first year, and there has been no sign of the couch grass since.

The farming activities of the Committee have demonstrated the growing of good crops on a profitable basis, especially when it is realized that the lands in question at the time they were taken over were valued under the Schedule of Plight at an annual rental of 5s. to 10s. per acre. A few cases may be quoted.

Some Instances of Land Improvement Before the war the clearings in Savernake Forest were bracken grazings for deer and rabbits; to-day some 450 acres are producing excellent crops of cereals, flax and potatoes. In 1942, 120 acres planted to potatoes gave an average yield of 9.9 tons per acre on land which was rented at 5s. per acre.

The reclamation at Malmesbury Common; known as King's Heath, is particularly interesting. This area of some 500 acres of heavy, clay land was given by King Athelstan in the year 941 to the Burgesses of Malmesbury and their successors. It was divided in the form of allotments, and to-day there are some 284 allotment-holders. The allotments are not necessarily cultivated singly; many are grouped to make larger fields. Malmesbury Common was cultivated during the 1914–18 war, but in the post-war period corn-growing was given up and, as the land is unwatered, it cannot be used for stock farming. Thus it became partially derelict, falling down to weedy pasture and scrub. The Committee, with the consent of the Commoners, took possession of the common early in the war, cleared many miles of

ditches and surface drains, and cut back overgrown hedges. It is now carrying good crops, mainly beans, wheat and leys, while the straw is fed back to cattle in straw yards. The labour for working the common is supplied from a Jewish Youth Movement Colony, known as "The Habonim".

On the Marlborough Downs, near Beckhampton, the Committee last year ploughed up a very rough and impoverished down and sowed it to barley. This work was carried out by the combined efforts of the Committee and the United States Army Engineers. The area is 160 acres (the American or Canadian "quarter section") and is reputed to be the largest field in England under a single crop.

In the south of the county 130 acres of light chalk land, valued at a rental of 5s. per acre and containing areas covered with juniper bushes, gave after clearing a cash sale of barley for the 1943 season of £3,500.

Reseeding of Grassland The survey of farms under the Four Year Plan has resulted in recommendations to sow down a great many of the fields which have now carried two or more corn crops since the outbreak of war, and to plough up a slightly larger acreage of old permanent grass. It is considered of great importance that the methods used in reseeding, and the fertilizers and seeds mixtures employed, should be designed to give new pastures of high productivity.

In addition to the sowing down of arable fields, there has been a very extensive programme of direct reseeding—often of rather difficult fields which for one reason or another are unsuited to corn-growing. This has been carried out by the Committee under contract on the basis of £10 per acre to cover cultivations, fertilizers and seeds mixture. It is expected that approximately 2,000 acres will be directly reseeded in this way during this season.

The type of mixture used for long leys, either for seeding or direct reseeding, will contain a proportion of Aberystwyth or other pedigree strains of grasses and S.100 white clover in conjunction with wild white clover. Examples of these mixtures are:

Mixture with Cocksfoot

lb.	
4	Italian ryegrass (preferably certified New Zealand).
8	Perennial ryegrass (Commercial).
8	Perennial ryegrass S.23 (or Kentish Indigenous or N.Z. Certified Pedigree).
6	Cocksfoot (3 lb. strain S.143 or S.37, with 3 lb. N.Z. strain).
2	Broad red clover.
2	Late-flowering red clover, S.123 or Montgomery strain.
½	Certified wild white clover.
1	White clover (S.100 strain).
31½	

On light upland soils 2 lb. per acre crested dogstail can be added if thought suitable.

Mixture without Cocksfoot

The same mixture as above but substituting 4 lb. timothy (Scotch, S.48 or S.51 strain) for the cocksfoot.

There is no doubt that the long ley system in conjunction with live stock is one of the best methods of maintaining soil fertility. The highest production of summer milk can be obtained by the application of nitrogen on new leys, which can be divided into paddocks by electric fencing for alternate grazing. Such land will also supply silage for winter feeding.

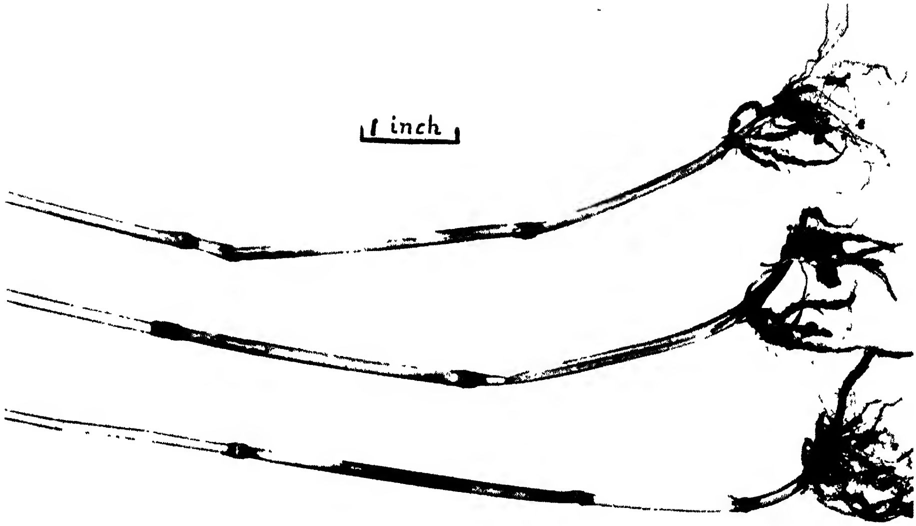
WAR-TIME FARMING IN WILTSHIRE

[Photo : *H. T. Cruston*

Young dairy bulls being reared at Bowden Park Farm, at present in the occupation of the Wilts W.A.E.C.

CALF-REARING ON A CUMBERLAND FARM (See pp. 354-6)

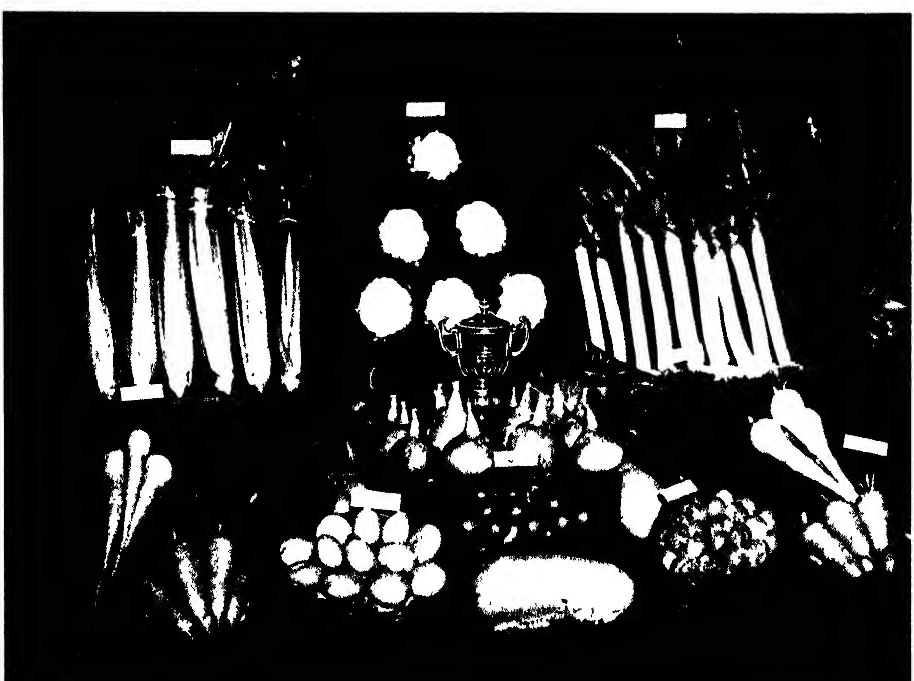
FROST INJURY TO THE STRAW OF WHEAT (See pp. 340-1)



(*Photo by H. H. Glasscock*

Straw with leaf sheaths removed, showing discoloration and (*centre*) kinking

ROYAL AIR FORCE UNIT GARDENS (See pp. 368-71)



(By courtesy of *Sport and Country*.

As an example of this system an 18-acre field on fertile chalk land was directly seeded on old arable in July, 1941, with a mixture of 16 lb. perennial ryegrass and 2 lb. S.100 white clover per acre, together with 2 cwt. per acre of compound fertilizer at the time of sowing. The field was then divided into four plots by the erection of electric fencing. From September 8 to November 1, the field was grazed by 100 ewes, and in the spring of 1942 the land was top dressed with sulphate of ammonia at the rate of 2 cwt. per acre. From April 1, until the end of July, the plots were alternately grazed by thirty-three dairy cows, yielding 100 gallons of milk a day throughout the period, except in July when the yield dropped to 80 gallons a day. This gives the extraordinarily high output of 630 gallons of milk per acre for the four months' summer grazing.

Seed Production It is realized that with the large acreage of land to be put down to long leys there will be a heavy demand for pedigree grass and clover seed within the county and for export to other counties; thus a considerable number of farmers, particularly on the better class chalk land in the east, central and southern portions of the county have taken up the growing of grass and clover seed under contract to merchants. It is expected that approximately 1,300 acres of Aberystwyth strains will be needed in the harvest of 1944 ; the largest acreage being that of S.23 ryegrass, either alone or with S.100 white clover. There are smaller acreages of S.101 ryegrass ; S.37 and S.143 cocksfoot ; S.48 and S.51 timothy and S.123 late-flowering red clover. In addition to these Aberystwyth strains, there are some areas growing wild white clover under the Ministry's scheme of certification, and a good deal of broad red clover and Dorset marlgrass, which the growers intend to manage specially for seed production.

The scheme for certification of cereal varieties has been considerably extended to cover all crops entered for certification where the variety is of known origin.

Live Stock It is appreciated that live stock, through the nitrogen circle, is the permanent basis of fertility. As Wiltshire is such a large milk-producing county, as far as cattle are concerned the Committee naturally concentrates on the dairy breeds, and its policy is both long- and short-term. The latter is for the immediate production of the maximum amount of winter milk (the summer production will then look after itself), while the long-term policy is for the general improvement of all live stock.

With these objects in view a comprehensive milk survey of every farm has been carried out, followed by the institution of a County Register of Classified Live Stock, and in the first instance to deal with dairy cattle. The Register is divided into three sections : Section I, for those herds that have been approved for bull calves ; Section II, for those herds that have been approved for heifer calves ; and Section III, an exchange and mart for older bulls of good breeding and proved fertility. Entries to the Register are based on minimum milk standards on official records and inspection. To date, over 1,000 cows have been approved both on conformation and milk records as bull breeders.

With approved dairy herds, and where conditions are suitable, farmers will be encouraged to breed and rear good milk bulls. The Committee has

set an example on one of the farms it has in hand, where some twenty-five bull calves are purchased annually. These are to be sold at a reasonable price as yearlings to go into the smaller herds in the county, so that the owner can obtain a sire with good conformation and milk ancestry without having to pay high pedigree prices.

It is also considered essential in relation to the fertility of the land that sheep should be increased. Every effort is being made to increase the pig population also; most farmers can keep a few good type breeding sows, which can be fed on the waste products of the farm and swill without drawing largely on rationed feedingstuffs. Breeding is encouraged by the formation of Pig Clubs and others with facilities for fattening pigs by the feeding of swill and household refuse. It is realized that at the end of the war there will be a heavy demand for good quality breeding pigs to meet the rapid expansion that will be required. This also applies to poultry, since there is no doubt that when the time is opportune there will be great possibilities of commercial egg production on the general farm. This could be done most successfully if the principle of superimposing folded poultry units on the almost unlimited areas of grass were adopted. Mr. Geoffrey Parsons, of Wishford, has put forward a scheme for the employment of ex-servicemen. After training, by arrangement with the farmer they could establish and maintain the necessary poultry units; this would be to the benefit of the farm and to the poultry-keeper. These men would also be able to supplement their income by working on the farms during rush periods, and this to some extent would meet the demands for seasonal labour, but the necessary cottage accommodation would have to be provided.

Four Year Plan Wiltshire, in common with other counties, is carrying out a survey under the Four Year Plan. This is concerned not only with cropping of the land but also with the equipment of the holding. In many instances before a suitable system of alternate husbandry can be introduced the installation of an adequate water supply and a considerable amount of fencing will be necessary. Such a system, however, can increase the livestock carrying capacity of the holding which, in turn, can absorb some of the labour which may be released through mechanization and other labour-saving devices introduced on the arable land.

The survey has also illustrated the lack of sufficient housing for the agricultural workers necessary to implement the proposed systems.

War-time food production in Wiltshire has shown that a great improvement can be made in the management of our farms—a fact which can be assessed not only by the additional amount of food grown but on personal observation when travelling through the county.

THE FARMING OF MARGINAL ARABLE LAND

J. H. Kirk, M.A.

Ministry of Agriculture and Fisheries

DURING the war we have all become familiar with the problem of what is termed "marginal land"; but by other names the problem has always been with us. Before the war large tracts in the region of the Pennines had a chronic tendency to be marginal, but the chief examples of the acute condition were in the East Midlands. A dozen or so areas, each making up a fair proportion of a county, stood out as black spots year after year; even a good year in the region as a whole, merely made these black spots grey. They were kept in cultivation only because the farmers living in the areas were willing to accept a low and uncertain standard of living, and the landowners were content with a bare minimum return on their capital. The condition of the land and buildings left much to be desired, and a bad year was inevitably followed by a number of bankruptcies.

These marginal areas have, however, shared in the general war-time improvement, and some of them, which produce good samples of malting barley, have even become relatively prosperous. But sooner or later the basic difficulties are bound to recur.

Occurrence of Marginal Land Common to all these areas is a history of comparatively recent agricultural development. They came into cultivation in response to the high corn prices during and after the Napoleonic wars, maintained a fairly steady, though by no means high, level of financial returns during the greater part of the nineteenth century, and started on a downgrade in the 1880s, with farms and fields dropping out of arable use one by one to revert to heath, bog and scrub. These marginal areas have thus illustrated the rule that the last land to come into cultivation is the first to go out; and again, no matter what the degree of agricultural prosperity, there will always be some marginal areas or marginal farms—that is, land which is incapable of giving more than a bare return at the ruling level of prices.

There is one sense in which the occurrence of marginal areas is a sign of a high standard of living. In China, where the standard is low, hardly any land is too poor to be worth cultivating; in Italy, again, mountains are cultivated which we should leave as rough grazings; but in England, we can maintain the standard of living to which farmers and farm workers are entitled only by concentrating on the better land. A rising standard of living therefore throws up marginal areas.

Three Areas Examined Some of these general principles, and others of equal interest, have been examined by Dr. S. M. Makings of the Midland Agricultural College, in one of the most useful books on agricultural economics which has appeared for some time—*The Economics of Poor Land Arable Farming* (Edward Arnold and Co. 18s.). Owing to the nature of its subject matter, the book necessarily contains a number of semi-political suggestions on which there will naturally be differences of opinion. But it is essentially a piece of economic diagnosis. Dr. Makings's method has been to examine various broad generalizations in the light of his detailed knowledge of three marginal areas in the East Midlands—the Nottingham sand land (Sherwood Forest), the poorer section of the Lincolnshire wolds, and the carr lands of the Ancholme Valley in North Lincolnshire. The first of these areas is distinguished by poor,

sandy, acid soils; the Lincolnshire wolds by thin light soils and a cold, late climate; the Ancholme Valley by a serious drainage problem. There are other difficulties too; but common to all three areas is a physical handicap of soil or climate.

Dr. Makings takes us for a tour of the three areas. With him we visit specimen farms in each of them—large and small farms, fertile and less fertile farms, well-managed and badly managed farms. The salient features of each are first described in "farmer's language," then given the critical appraisal of the economist. So able is the writing in this section of the book that although I have visited two of the areas many times, I feel that I know them better from Dr. Makings's description than from my own observation.

Physical Handicaps and Low Farming Standard This descriptive section leads to the question whether the depressed financial conditions are due mainly to the physical handicaps as such, or to other difficulties produced by those handicaps, such as a low standard of farming. This may appear to be a distinction without a difference, but a little reflection will make the point clear. If the depressed conditions are due directly and solely to physical limitations imposed by Nature, there is probably no hope of a cure, but if the physical difficulties operate indirectly, then there may be some hope of breaking the chain of cause and effect. This explains Dr. Makings's concern with standards of efficiency—a concern which is evident throughout his book.

To the economist there is much more in this term than it connotes to the layman. To the latter, "efficient" means personally competent, and "inefficient," incompetent. To the economist, however, "inefficient" may embrace several other factors, even some quite outside the farmer's control, which handicap the earning of a profit. At the one extreme "inefficiency" means simply that the farmer is a born muddler; the areas delineated by Dr. Makings contain some farmers who have migrated to them after failing in better areas elsewhere. A stage higher comes the farmer who has not enough capital to make a success of his farm; this type includes the young man who hopes to compensate by his labour what he lacks in capital. A particular form of capital shortage, especially on the Lincolnshire wolds, is represented by insufficient machinery for large arable acreages. However, this is less common now than before the war.

Then there is the farmer who may be practising with much skill a type of farming plainly unsuited to his district, or what is rather more difficult to correct, a system which most farmers in the district regard as the only one possible, though they have the evidence of their bank passbooks for its lack of success. The Lincolnshire wolds are a case in point. This area makes use of a fairly orthodox four-course system, and in the main with a high standard of skill, except that, as Dr. Makings points out, many farmers tolerate an excessive rate of sheep losses. The four-course system is probably the most productive of all systems on light land of not high quality, but before the war it was an expensive system in relation to sheep and barley prices. A few farmers expanded or diversified cash cropping with wheat, potatoes, sugar beet or vegetables to the greatest extent that their land would bear—and generally with good results; but many others refused to attempt either this cropping or any other variant of the four-course system, and gradually drifted into the position where, through capital depletion, they could not successfully carry on with any system.

Then, as further examples of "inefficiency," we have the case of the man whose farm may be too small or too large for the system he has chosen, or whose farm may have a hopelessly inconvenient lay-out.

Size of the Farm and System of Husbandry Dr. Makings makes an interesting point on the subject of farm sizes. Many farmers coming into his areas—especially the Sherwood Forest—started at once to farm on the four-course system, purely because it was the traditional system of the district, without regard to the minimum size of farm which that system requires. (Dr. Makings puts it at 100 acres where the land is of medium or low fertility.) Thus on smaller acreages than this there was never the possibility that the four-course system could provide the farmer with a living. Some of the occupiers of these smaller farms, when they realized this, went over to producer-retailing of milk, or added pig-keeping and vegetable growing to their businesses, again with good results, but others merely continued to plug away at the impossible.

At this point I should like to interpose a few words to clear up a seeming contradiction in Dr. Makings's diagnosis. He points out that many farms in his areas are too small to provide a living, but nevertheless there is a theme running through his book to the effect that the farmers would be well advised to cut down the sizes of their farms by abandoning their worst fields—those that can never repay the costs of cultivation—and to concentrate their inadequate resources on the better fields. It would seem that if the four-course system is to be pursued, a good many of the farms must be enlarged—for example, two thrown into one—but at the same time there is no point in wasting money on hopeless fields; if the good fields do not make up a sufficient area, then there is nothing for it but to change the system.

Farm Lay-outs On the subject of farm lay-outs, Dr. Makings cites examples of quite small farms straggling over a whole parish, and he is inclined to the opinion that bad lay-outs are as great a cause of depressed conditions in his areas as any other factor. No indication, however, is given that lay-outs are worse in his three marginal areas than elsewhere; unless they are so they cannot really explain any particular difficulties in the marginal areas. Dr. Makings is on firmer ground when he argues that the inconvenient shapes of farms are less likely to be corrected by the landlords in his areas than in most others, since the rents are too low, tenancies too brief, and prospects too uncertain, to provide the incentive

Relations between Landlord and Tenant On the general subject of landlord-tenant relations, Dr. Makings has endeavoured to preserve a balance. He recognizes that the landlords have consented to drastic rent reductions and abatements—in the Sherwood Forest area exceeding 30 per cent.—but he considers nevertheless that they should evince a greater willingness to share the risks of their tenants. He criticizes the system under which, as he explains the matter, the landlords set a rent and then watch a succession of tenants fail to pay their way. He would sooner see them accept a lower rent which the tenants could pay, and live. Dr. Makings does not, however, inquire very closely whether such rents would provide for the maintenance of the properties, and unless the general standard of prosperity could be raised, there is room for doubt in the matter.

From this general survey we return to the original question whether the depressed conditions of the areas should be attributed solely or directly

to climate and soil, or to "inefficiency," using that term in its widest sense. From what has already been said it will be gathered that in the view of Dr. Makings the physical handicaps do directly account for some of the economic difficulty, but also that that difficulty is considerably accentuated by inefficiency.

The Question of "Efficiency" In so far as inefficiency is a curable condition this conclusion is germane to the question whether we can or should look forward to the survival of these three areas as going concerns. Dr. Makings's opinion on this point seems to be that if farming conditions in an area are not such as to afford a reasonable living to tenants and workers, the land (or at all events the worst of it) should be allowed to go out of cultivation, and should be converted to woodland and other uses.

If this seems too drastic, the answer is that such an abandonment of cultivation will not be necessary to just the extent that efficiency can be increased; and from this point of view the important thing is to identify those forms of inefficiency in the marginal areas that are likely to be remediable, and then, if possible, to set about remedying them. This is bound to be a slow process, engaging the attention and effort of the authorities, the landowners, and not least, the farmers in the areas. In the meantime everyone interested in marginal farming areas—certainly the farmers themselves in those areas—could not do better than read Dr. Makings's book from cover to cover.

ERADICATION OF WILD ONIONS

J. R. TINNEY

Saffron Walden, Essex

IT is now two years since an article appeared in this JOURNAL describing my method of eradicating the wild onion.* Soon after, two fields were selected to test the method under official supervision. One of these, a field of 16 acres known as "Upperfield," on Clinton's Farm, Little Hadham, Bishops Stortford, Herts, is farmed by Mr. G. Harvey, and the other of 12 acres, known as "Painters Field," Saffron Walden, Essex, is farmed by Mr. C. G. Engleman, Saffron Walden. The Hertfordshire field is supervised by Mr. J. Hunter Smith, B.Sc., Principal of Oaklands Farm Institute, and the Essex field by Mr. J. Bryce, B.Sc., of the Essex Agricultural Institute, Chelmsford.

Trials in Herts and Essex Operations were begun in November, 1942, both fields being ploughed deeply during that month for cropping with potatoes in 1943. Thereafter they remained in the furrow until the first week in March, when they underwent thorough cultivations for the potatoes.

Prior to the ploughing of these fields, a considerable amount of young wild onion growth above ground indicated a very heavy infestation. There were no signs of reproduction below ground. A similar amount of young growth, 4–6 in. tall, was again showing by the end of February and offset bulbs were beginning to form underground. As was to be expected, the

* December, 1942, 49, 155.

thorough preparation of the land for the potatoes destroyed all growing plants, and nothing more appeared until September, when the potato haulm had begun to die down. Then young onion growth appeared in the ridges. This was effectively dealt with during digging operations in October.

The fields were ploughed again in November, and as both farmers concerned are dairymen, spring corn was selected for spring growing. Owing to the exceptionally mild winter of 1943–44, a very strong growth of young onions appeared rather earlier than usual. The Herefordshire field was cross-ploughed in February and the Essex field steam-harrowed in early March, and the oats drilled. No more onions were observed during the growing season. After harvest, however, very small and tender plants could be seen in the stubble, but not more than 20 per cent. of the numbers encountered two years previously, and these will not have time to reproduce as the fields will again be ploughed in November or December.

In the winter of 1942–43 wild onion growth generally came from terminal and major offset bulbs, and to a less extent from minor hard offsets and bulbils. During the winter of 1943–44 growth came from the hard offsets and bulbils. In succeeding years a marked and progressive decrease in the number of young plants is to be expected, and these are likely to come mostly from the small hard-shelled offsets and bulbils.

For 1945, Mr. Harvey proposes to grow sugar beet and potatoes, and Mr. C. G. Engleman potatoes.

The Right Time to Plough It must again be emphasized that an infested field should not be ploughed earlier than November. I have come across instances where ploughing has been done during the last ten days of October and the field subsequently sown with spring corn. Cultivations were not sufficiently drastic, with the result that wild onions reappeared by late April. To make an effective job the work must be carried out at the times recommended, and to combat the ill-effects of two such abnormally mild winters as we have experienced for the last two years, ploughing should be delayed until *mid-November*. Further, to destroy effectively every growing plant the farmer must at all costs carry out such spring cultivations as are necessary from the beginning of March until the end of April. He should bear in mind that it is the terminal and the strongest and most vigorous of the offset bulbs that germinate during the first two or three years and which produce the strongest and most vigorous plants. One can readily understand that it is not always easy or convenient to cultivate sufficiently to destroy every growing plant and at the same time grow a satisfactory crop of spring corn, but if roots are taken twice in the first three years, the onions are effectively dealt with in the ordinary course of cultivation during their years of strongest growth.

This is not to suggest that complete eradication cannot be obtained by six years of spring corn, but it would be extremely difficult and certainly not the best farming practice.

The viability of wild onions appears to be comparatively short—six years or less. Therefore it is imperative to prevent reproduction during that time.

A very valuable article by Miss R. H. Scott, of the Botany School, Cambridge, in the July, 1944, issue of this JOURNAL set out facts in the life cycle of the wild onion which tend to support the method of eradication by cultivation. Miss Scott states that the period of greatest susceptibility of the plant to cultivation is probably mid-February, when its food reserves are most depleted.

American Parallel Since the publication of the first article on this subject, I have been in correspondence with Mr. C. E. Skiver, Department of Agronomy, Purdue University Agricultural Experimental Station, Lafayette, Indiana. The remarkable point about Skiver's method is the coincidence of its almost complete agreement with the method carried out here for so many years. There is, however, one point of difference: Skiver claims that two years is usually sufficient to eradicate the weed. This is quite likely in Indiana, for although the Central States of the U.S.A. may suffer severe winters, their early spring may attain much higher temperatures than we get in this country, thereby causing maximum germination during the first two years. But from my own experience this is definitely not the case in this country. The great problem here is how to induce all the bulbs and bulbils to germinate under 5 or 6 years.

Viability of Bulbils under Test In order to prove the viability of bulbils, major and minor offsets, an experimental plot has been laid out here with bulbils supplied by Mr. J. Bryce and collected by him in 1938 and 1941, also bulbils of 1944 growth, and major and minor offset bulbs collected in the spring of 1944. A certain number of each has been planted to obtain evidence of the length of time bulbs and bulbils will remain viable and the proportion that may be expected to grow each year under field conditions. It is also hoped to observe more closely what form reproduction takes in the three types, and whether reproduction occurs at all during the summer in those plants which appear above ground late in the season.

ROYAL AIR FORCE UNIT GARDENS

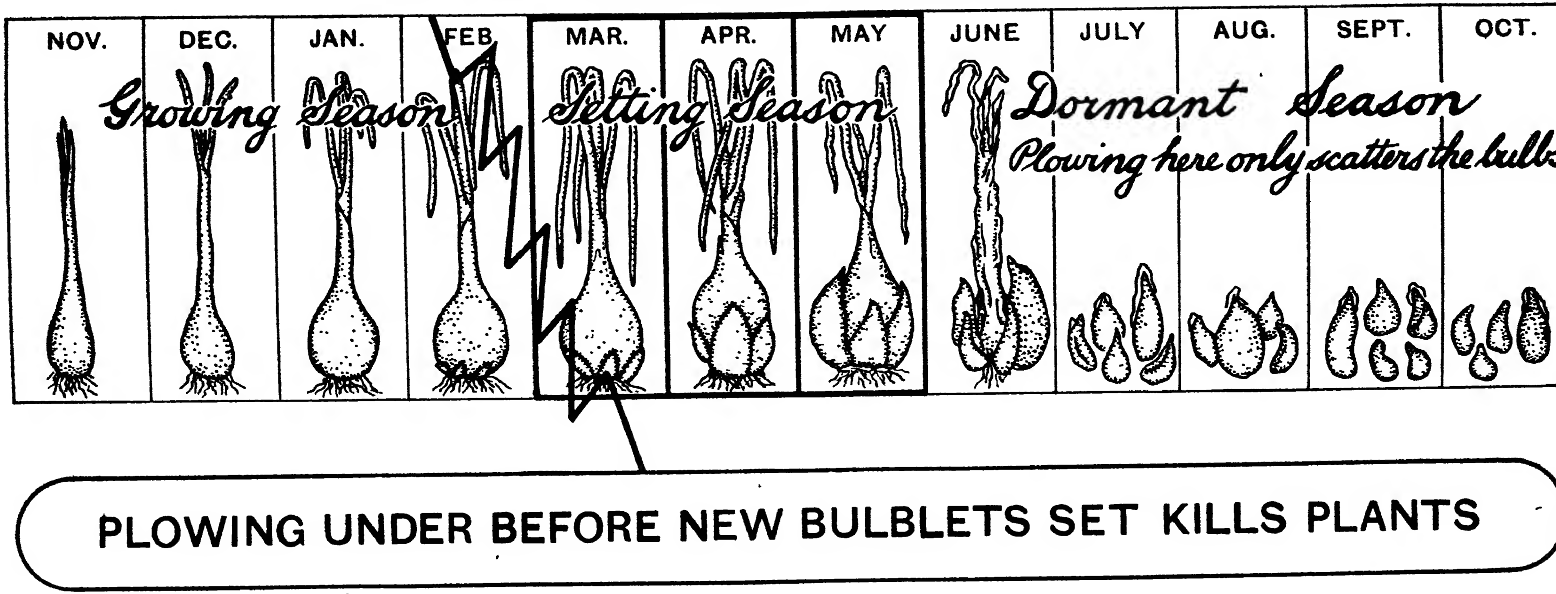
Miss E. H. Crowther

Wisbech, Cambs

VICTORY gardening has many facets, and it is engaging the attention of several organizations throughout Great Britain. The efforts of some obtain well-merited publicity, while those of others can, for certain reasons, receive only a minimum of recognition. It is not often that one is enabled to see a little of what is being done in the matter of food production at a number of R.A.F. aerodromes in Britain, but it can be stated categorically that this not inconsiderable section of the community is making a most impressive contribution, in spite of its preoccupation in a more arduous sphere of the war effort. The following account of the difficulties which have had to be surmounted, and of the results which are being achieved, is made after visiting certain units in the eastern counties. In many other parts of Britain similar good work is going forward.

Difficulties of Site and Soil The site of an aerodrome is hardly ever such that it would be chosen by an intending gardener. It may be on either a plateau or flat lowland, and is marked by an absence of trees and tall hedges. There is nothing to obstruct the view or, incidentally, to break the force of the wind. Crops must be grown entirely in the open, with no sort of protection from the weather. This is all very pleasant on a calm summer's day (a relative phenomenon !)

PROPER CULTIVATION CONTROLS GARLIC



1. Plowing wild garlic plants under before they set underground is a very effective way to kill them.
2. The old plants die back every year to the new underground sets (bulblet growth). When this setting is prevented the plants die.
3. A good job of plowing during the growing season in November, December, January or February, followed by a thorough discing and dragging early in the spring, has proved very effective.
4. The field need not lay idle but may be used for any annual crop such as corn, oats or soybeans.

Wild garlic is a winter growing plant. Effective control cultivations must be made in late fall, winter or early spring.

Reproduced by courtesy of C E. Skiver, Agricultural Extension Department, Purdue University, Lafayette, Indiana

but it can be most disagreeable at other times. In consequence of this exposure, one may see areas, particularly on light soils, where both the seeds, and the seedbed in which they were sown, have been blown away before germination could take place. And this may happen more than once in a season.

The selection of sites for cultivation, of course, is limited by operational requirements. In most cases the cultivated areas, varying from ½ acre to 10 acres, are scattered widely over the flying ground. These may be as much as half a mile apart, while the total area of the garden ranges from 30 acres or less to over 90 acres. Indeed, a bicycle is a necessary part of the R.A.F. gardener's equipment !

The soil is another factor beyond control. It is often only a thin covering on top of the subsoil or native rock. It may be a light and hungry silt overlying chalk, or an unproductive clay requiring years of unremitting cultivation to bring it into something like a fertile state.

As a rule farmyard manure, or other form of organic matter, is unobtainable. Fertility is usually maintained by the use of compost, green manures, and, occasionally, under certain conditions, sewage sludge. In some cases compost is made on the Station in considerable quantity, the bulk of it from rough grass trimmings, which are easily obtainable. But this involves carting the material over long distances. Pig-keeping is another source of organic matter. One unit has made a special feature of this, and about fifty pigs of different ages do well on swill collected from outlying sections and camp canteens. Chemical fertilizers are used as far as the allocation will allow.

Labour Scarcity Offset by Mechanization Most units take full advantage of mechanized farm machinery. Some possess their own implements, including a tractor, plough, cultivator, planter and potato-lifter. Others hire a tractor as required, but have their own implements for use with it. Indeed, the labour problem is such that without mechanization the objective of becoming as nearly self-supporting in vegetables as possible could not be achieved.

The man-power aspect, which superficially may seem straightforward, is, in practice, a major problem. In an operational unit, at any rate, service work is going on continuously day and night. As a rule, one man is appointed to take charge of the garden work as a more or less whole-time occupation. Assistance from R.A.F. personnel is on a voluntary basis. Generally a limited amount of such voluntary help is forthcoming when required, but it depends, of course, upon the keenness and initiative of those responsible for the organization. In addition, one or two members of the Women's Land Army may be employed, and where this is so they have given a very good account of themselves.

The Crops The crops grown are mostly those which will provide green vegetables throughout the year, with particular emphasis on winter- and spring-maturing brassicas. These are supplemented by root crops which can either be consumed as harvested, or stored for winter use. Bearing in mind the conditions of cultivation and of large-scale cooking, the hardiest, most easily harvested and prepared vegetables are grown. General popularity in the messes is also considered. Some units do very well with salad crops, while another generally popular summer vegetable is the marrow. Peas and beans are not grown in any quantity, owing to the amount of hand labour required in their preparation for table.

The same consideration applies even to brussels sprouts, although they are grown by some units. Some potatoes are grown, but unless the acreage cultivated is large it is better policy to concentrate on producing those vegetables which are less readily obtained and transported in bulk. Potatoes do, however, fill a useful place in the rotation, or where ground has been freshly broken up from grass, and when the early crop comes in, it is much appreciated.

Per Ardua . . . There is one striking advantage which the unit gardens enjoy by virtue of their open and sometimes isolated situation—comparative freedom from common pests and diseases. The chief depredations are by rabbits, but their attacks are not, on the whole, serious. A continuous and hard struggle has, however, to be made against weeds. This is largely because much of the land is newly broken and of rather low grade, containing large quantities of thistles, twitch and other perennial weeds. Also the areas cultivated are readily infested by weed seeds from adjoining rough land.

It is a striking testament to the R.A.F. that, accustomed as they are to overcoming difficulties in operational matters, they can show such keenness, forethought and organization in making this valuable contribution to the country's food supply.

A GOOD SHOW

The R.A.F. Fruit and Vegetable Show held in the Royal Horticultural Society's New Hall, Westminster, London, on October 10 and 11, demonstrated in no uncertain manner the wide range and the excellent quality of the produce being grown on Unit Gardens.

Dr. H. V. Taylor, the Ministry's Horticulture Commissioner had no easy task in finally judging the competition for the best-garden. The award to Bircham Newton was made only after the closest examination of the merits of nine runners-up. The Royal Horticultural Society's Challenge Cup, a new trophy for the best exhibit at the Show, went to a Scottish Station. Some idea of the quality of the produce can be gained from the illustration facing p. 361.

But the R.A.F. does not believe in quality alone. During 1944 the Unit gardens have delivered no less than 14,000 tons of mixed vegetables to their messes, besides considerable quantities of lettuces, radishes and other foodstuffs supplied unweighed. Last year R.A.F. gardeners provided produce to the value of £285,000 from some 7,100 acres. It seems that a new meaning has been given to combined air and land operations.

MANURE LOADERS

National Institute of Agricultural Engineering, Askham Bryan, York

SEVERAL types of farmyard manure loaders are being developed in an attempt to solve one of the greatest labour problems on the general farm. Some are fitted with small stationary engines and do not, therefore, require a tractor at a time when it may be wanted for other work. Others are either mounted on, or hitched to, a tractor and driven from the belt pulley or power take-off.

The fork-and-elevator type consists of a self-powered winch, fork, and elevator. The operator causes the winch to draw the fork towards the elevator, while his assistant guides the fork and ensures that a good load is deposited on the conveyor. Tests have shown that two men and one girl, the latter loading the trailer or cart, can elevate nine tons of dung per hour. This may not be a great saving of time, but the physical effort is reduced. The loader moves about the yard under its own power.

MANURE LOADERS

The crane or grab type is more for the contractor than the ordinary farmer. The large grab and rather heavy crane make manoeuvring difficult; covered yards cannot usually be entered; and a large carting team is necessary to keep the loader busy. Manure loaded by this method is sometimes difficult to unload by hand, but in open yards, and on field heaps, saving in labour of 10–50 per cent. has been recorded. Two men operate the crane and a third loads the trailer.

The buckrake type consists of a scoop-like fork attached to the front of a tractor. By means of a winch it may be raised several feet and transported in that position. The buckrake is driven into the manure, raised, and tripped over the cart or trailer. A skilled tractor driver is necessary, and he may have difficulty in controlling his tractor on the wet, greasy bottom of the yard or muck heap. Under ideal conditions in the open this loader has worked at 6½ and 5 tons per man-hour, where each fork load had to be carried 24 and 50 yd. respectively.

A fourth type, which is mounted on a tractor, has an elevator, and a series of blades on a shaft at the rear of the tractor. These blades revolve, digging out and pulverizing the manure, which is elevated into a trailer.

FIVE YEARS OF WAR-TIME FARMING

DURING the war there has been ample indication that British farming achievement has been high, but now that detailed figures of agricultural production for England and Wales and the United Kingdom have been released for publication, the full extent of our food production effort and the unqualified success which has attended it can be measured exactly. The total area available for crops and grass has been steadily diminishing for years as building has increased, and further demands have been made upon it during the war for military and industrial purposes. Although reclamation, often of most difficult land, has been considerable, the total crops and grass area has actually fallen by 300,000 acres in England and Wales (600,000 in the United Kingdom). Yet on this decreased agricultural acreage the total tillage (crops and fallow) has been increased by nearly 70 per cent. (England and Wales) and nearly 66 per cent. (United Kingdom), and our cattle population increased by 6.5 per cent. (England and Wales) and 7.6 per cent. (United Kingdom).

It will be noted that there has been an upward trend in rough grazings, but here it should be explained that much reclassification of the grassland has occurred and that it is impossible to make a perfectly clear-cut distinction between permanent grass and rough grazing. The increase in rough grazings represents in part a rise in the actual utilization of the rough ground of the country.

The great expansion in the acreage of corn crops is particularly noteworthy. Indeed, this war has seen the greatest corn-crop acreages in recorded agricultural history; the highest grain acreage recorded hitherto was in 1869—7,395,000 acres in England and Wales.

The acreage devoted to potatoes has been more than doubled, and this crop again is far and away greater than at any time in the country's history—527,000 acres have been added since 1939.

Practically the whole of the glasshouse acreage has been turned over to tomatoes. In 1939, 60 per cent. was devoted to this crop in summer; in 1944, the proportion is nearer 90 per cent. As regards outdoor tomatoes, there has been a steady increase in England and Wales since 1939 from a mere 20 acres to nearly 5,000 acres in 1944.

The development of home flax production in Great Britain has been one of the outstanding achievements of the war. The acreage grown for fibre in England and Wales in 1939 was trifling; in 1944, it has risen to 51,000 acres. Northern Ireland farmers have raised their acreage from 21,000 in 1939 to no less than 125,000 in 1944.

Turning to fodder crops, we find an increased acreage of 500,000 in England and Wales (about 50 per cent.) and nearly 600,000 in the United Kingdom (over 40 per cent.). Before the war 8–9 million tons of feeding-stuffs were imported as such or produced at home from imported materials. These imports have now been reduced to small dimensions, and a vast quantity of shipping space saved in consequence. Among roots, the increase in the acreage of mangolds, cabbage and kale is most striking.

The increase in the cattle population of England and Wales from 6,770,000 (1939) to 7,209,000 (1944), and in the United Kingdom from 8,872,000 (1939) to 9,546,000 (1944), largely reflects the efforts made to promote milk production—a prime object of Government policy. The higher proportion of dry cows may be ascribed to the tendency to have a longer dry period under present conditions. The numbers of sheep, pigs and poultry have, of necessity, been reduced substantially *vis à vis* the feedingstuffs position, but there is reason to believe that the bottom of the trough has now been reached and that 1945 will be marked by an upward trend.

Shortage of space has not permitted more than a very brief commentary of the following statistics. Readers will, however, be able to clothe the bare figures for themselves and appreciate that they are but the index of the unceasing effort which all those engaged directly or indirectly in winning our food from the soil have made with unflagging resolution.

Agricultural Statistics—England and Wales

I. ACREAGE OF CROPS AND GRASS

June 4 Agricultural Returns, England and Wales, each year from 1939 to 1944

(thousand acres) (a)

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
Wheat	1683	1697	2141	2391	3276	3066	+82.2
Barley	910	1218	1342	1364	1556	1723	+89.3
Oats	1358	2094	2430	2499	2197	2227	+64.0
Mixed Corn	83	253	520	524	479	412	+396.4
Rye	16	20	49	67	123	116	+625.0
Total Grain	**4051**	**5282**	**6482**	**6845**	**7632**	**7544**	**+86.2**
Beans, for stockfeeding	133	86	186	215	238	276	+107.5
Peas, for stockfeeding	37	38	64	68	64	57	+54.1
Potatoes, first earlies	56	61	88	103	125	141	+151.8
Potatoes, main crop and second earlies	398	476	689	795	832	840	+111.1
Total Potatoes	**454**	**537**	**777**	**898**	**957**	**981**	**+116.1**

(*continued overleaf*).

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
Turnips and Swedes, for fodder	(b)396	(b)434	491	506	480	473	+19.4
Mangolds	210	221	258	261	279	301	+43.3
Sugar beet	337	323	344	412	404	420	+24.6
Rape	53	72	91	123	132	151	+184.9
Cabbage, Kale, Savoys, and Kohlrabi, for fodder	94	114	192	179	189	197	+109.6
Vetches	49	32	45	48	53	50	+2.0
Lucerne	32	31	28	32	(c)	(c)	
Mustard, for seed ..	24	24	17	22	16	12	—50.0
Mustard, for fodder or ploughing in ..	24	30	28	27	30	29	+20.8
Flax, for fibre or linseed	4	27	61	68	60	65	+1525.0
Hops	19	19	18	18	19	20	+5.3
Orchards with crops, fallow or grass below the trees	236	240	254	250	253	248	+5.1
Orchards, with small fruit below the trees	18	17	16	15	13	15	—16.7
Small Fruit, not under orchard trees ..	29	25	22	20	18	18	—37.9
Total Fruit ..	**284**	**282**	**292**	**285**	**284**	**282**	**—0.7**
Vegetables for human consumption (excluding potatoes), Flowers, and Crops under Glass (d) ..	275	275	341	379	366	450	+63.6
All Other Crops ..	32	35	64	81	95	82	+156.2
Bare Fallow	355	300	213	274	234	224	—36.9
Total Crops and Fallow (Tillage) ..	**6862**	**8162**	**9991**	**10741**	**11531**	**11615**	**+69.3**
Clover, Sainfoin and Temporary Grasses for mowing ..	1304	1306	1170	1504	1726	1907	+46.2
Clover, Sainfoin and Temporary Grasses for grazing ..	768	671	597	606	751	1067	+38.9
Total Temporary Grasses	**2072**	**1977**	**1767**	**2110**	**2476**	**2973**	**+43.5**
TOTAL ARABLE LAND	**8935**	**10139**	**11758**	**12850**	**14007**	**14588**	**+63.3**
Permanent Grass for mowing	4612	4235	3734	3211	2685	2313	—49.8
Permanent Grass for grazing	11097	10198	9095	8432	7667	7437	—33.0
TOTAL PERMANENT GRASS ..	**15709**	**14433**	**12829**	**11643**	**10352**	**9750**	**—37.9**
TOTAL ACREAGE OF CROPS AND GRASS EXCLUDING ROUGH GRAZINGS ..	**24643**	**24572**	**24587**	**24493**	**24358**	**24339**	**—1.2**
Rough Grazings ..	5541	5527	5633	5592	5593	5751	+3.8

(a) Each individual acreage figure is rounded to the nearest thousand acres.
(b) Includes acreage grown for human consumption.
(c) Included under Temporary Grasses.
(d) For details see following Table. Includes peas harvested dry.

FIVE YEARS OF WAR-TIME FARMING

ACREAGE OF HORTICULTURAL CROPS IN ENGLAND AND WALES EACH YEAR FROM 1939 TO 1944

(*thousand acres*) (a)

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
Brussels sprouts ..	38.0	33.1	28.0	36.8	35.3	37.4	—1.6
Cabbage, Savoys, Kale and Sprouting broccoli	44.1	48.8	37.5	57.3	50.2	66.8	+51.5
Cauliflower or Broccoli (Heading)	18.9	16.7	17.5	17.6	19.8	25.1	+32.8
Carrots	16.1	24.9	33.5	27.9	26.0	35.2	+118.6
Parsnips	(b)	(b)	6.5	7.1	6.0	6.7	
Turnips and Swedes (not for fodder) ..	(b)	(b)	9.0	11.8	11.3	11.7	
Beetroot	(b)	(b)	8.6	12.7	9.2	10.8	
Onions	1.7	3.0	13.4	9.5	12.4	15.4	+805.9
Beans, Broad ..	17.8	15.8	5.2	6.0	5.8	7.8	+6.7
Beans, Runner and French			8.9	8.4	8.9	11.2	
Peas, green for market	60.6	53.1	48.2	50.6	44.0	62.5	+3.1
Peas, green for canning	28.0	40.5	18.4	18.8	13.1	15.1	+331.1
Peas, harvested dry			71.2	79.1	89.9	105.6	
Asparagus	2.6	2.3	2.1	1.9	1.6	1.5	—42.3
Celery	6.7	4.2	4.2	4.4	4.9	6.2	—7.5
Lettuce	5.9	5.1	4.6	5.3	5.5	7.5	+27.1
Rhubarb	7.2	6.6	6.0	5.9	5.9	6.4	—11.1
Tomatoes, growing in the open	0.2	0.3	1.5	2.9	3.9	4.8	+2300.1
All Crops growing in Glasshouses or Frames	3.3	3.3	3.6	3.6	3.8	3.8	+15.2
Hardy Nursery Stock	10 5	8.5	5 8	5.4	5.0	4.9	—53.3
All Bulb Flowers, not under glass ..	7.7	6.2	5.0	3.9	2.0	1.9	—75.3
Other Flowers, not under glass ..	5.8	2.9	2.4	2.1	1.3	1.5	—74.1
Total Vegetables for human consumption (excluding potatoes), Flowers and Crops under Glass	**275.0**	**275.4**	**341.3**	**378.9**	**366.0**	**450.0**	**+63.6**

(a) Each individual acreage figure is rounded to the nearest thousand acres.
(b) Not separately returned.

II. ESTIMATED PRODUCTION OF THE PRINCIPAL CROPS IN ENGLAND AND WALES 1936-8 AND 1939-44

(*thousand tons*) (a)

Description	1936-8	1939	1940	1941	1942	1943	1944 (Preliminary Forecast)
Wheat	1542	1555	1513	1882	2420	3249	2959
Barley	681	794	985	1013	1273	1413	1507
Oats	1029	1119	1753	1926	2158	1820	1838
Mixed Corn	75	72	218	416	443	374	340
Rye (for threshing) ..	9	9	10	25	43	87	83
Total Grain ..	**3335**	**3549**	**4479**	**5262**	**6337**	**6943**	**6727**
Sugar Beet	2686	3469	3119	3168	3841	3656	3741
Potatoes	3142	3312	4154	5414	6651	6775	6770
Turnips and Swedes, for fodder	4961	4758	4791	5944	6875	5884	5292
Mangolds	3984	3938	4018	4928	5278	5669	5305
Seeds Hay	1699	1700	1700	1554	2120	2428	2316
Meadow Hay ..	4279	4535	3669	3578	3052	2668	1839
Total Hay	**5978**	**6235**	**5369**	**5112**	**5172**	**5096**	**4155**

(a) Each individual production item is rounded to the nearest thousand.

III. LIVESTOCK POPULATION

June 4 Agricultural Returns, England and Wales, each year from 1939 to 1944

(*thousand*) (a)

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
Cows and Heifers in milk	2255	2270	2286	2211	2295	2308	+2.4
Cows in calf but not in milk	392	395	429	479	524	537	+37.0
Total	**2646**	**2665**	**2715**	**2690**	**2819**	**2845**	**+7.5**
Heifers in calf ..	459	512	471	655	628	637	+38.8
Bulls for service ..	91	92	93	101	107	108	+18.7
Other cattle two years old and above:							
Male	(b)	447	381	442	417	429	
Female	(b)	562	492	452	468	536	
Total	**944**	**1009**	**873**	**895**	**884**	**965**	**+2.2**
Other cattle one year old and under two:							
Male	(b)	470	470	367	335	305	
Female	(b)	874	917	841	909	963	
Total	**1346**	**1345**	**1387**	**1208**	**1244**	**1269**	**—5.7**
Bulls (incl. bull calves) being reared for service	43	46	49	59	58	56	+30.2
Other cattle under one year old:							
Male	(b)	(b)	(b)	370	315	321	
Female	(b)	(b)	(b)	936	995	1008	
Total	**1242**	**1333**	**1254**	**1306**	**1310**	**1328**	**+6.9**
TOTAL CATTLE ..	**6770**	**7001**	**6841**	**6913**	**7050**	**7209**	**+6.5**
Sheep under one year old:							
Rams for service ..	205	198	158	154	142	139	—32.2
Ewes for breeding ..	7160	6958	5795	5507	4985	4893	—31.7
Two-tooth (shearling) ewes ..	1477	1446	1172	1132	1248	1330	—10.0
Other sheep over one year old ..	1021	1262	1268	957	887	794	—22.2
Total over one year old	**9863**	**9864**	**8392**	**7750**	**7262**	**7156**	**—27.4**

(*continued opposite*)

DESCRIPTION	1939	1940	1941	1942	1943	1944 (Preliminary)	PERCENTAGE CHANGE 1944 on 1939
Sheep under one year old:							
Ram lambs for service	156	85	62	60	58	61	—60.9
Other lambs ..	7967	7734	6232	6122	5613	5414	—32.0
Total under one year old	**8123**	**7819**	**6294**	**6182**	**5671**	**5476**	**—32.6**
TOTAL SHEEP AND LAMBS ..	**17986**	**17683**	**14686**	**13932**	**12933**	**12632**	**—29.8**
Sows in pig	(b)	217	94	88	61	79	
Gilts in pig	(b)	66	32	41	31	63	
Other sows for breeding	(b)	112	71	70	52	65	
Total Sows for breeding ..	**449**	**395**	**197**	**200**	**144**	**208**	**—53.7**
Barren sows for fattening	(b)	36	25	17	16	11	
Boars for service ..	30	28	16	16	13	17	—43.3
All other Pigs:							
Over 5 months ..	633	735	550	477	501	425	—32.9
2–5 months ..	1516	1456	841	606	442	466	—69.3
Under 2 months ..	888	710	360	361	266	341	—61.6
TOTAL PIGS ..	**3515**	**3360**	**1989**	**1678**	**1381**	**1467**	**—58.3**
Fowls over 6 months old	23154	25739	24763	17294	13324	12990	—43.9
Fowls under 6 months old	29758	25438	15348	16678	13135	15855	—46.7
Total	**52912**	**51178**	**40111**	**33972**	**26459**	**28846**	**—45.5**
Total Ducks ..	**2237**	**2037**	**1612**	**1764**	**1691**	**1964**	**—12.2**
Total Geese ..	**584**	**582**	**599**	**623**	**676**	**745**	**+27.6**
Total Turkeys ..	**693**	**583**	**388**	**323**	**294**	**353**	**—49.1**
TOTAL POULTRY	**56426**	**54380**	**42709**	**36682**	**29121**	**31907**	**—43.5**
Horses used for agricultural purposes (including mares kept for breeding) ..	549	541	564	485	520	487	—11.3
Unbroken horses of one year old and above	110	107	97	90	75	74	—32.7
Light horses under one year old	15	13	10	8	8	8	—46.7
Heavy horses under one year old ..	35	31	27	25	25	23	—34.3
Stallions being used for service in the current year	5	3	3	3	3	3	—40.0
All other horses (not entered above) ..	132	123	123	172	114	115	—12.9
TOTAL HORSES ..	**846**	**820**	**824**	**783**	**745**	**711**	**—16.0**

(a) Each individual livestock item is rounded to the nearest thousand.
(b) Not separately returned.

Agricultural Statistics—United Kingdom

I. ACREAGE OF CROPS AND GRASS

June 4 Agricultural Returns, United Kingdom, each year from 1939 to 1944

(*thousand acres*) (a)

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
Wheat	1766	1809	2265	2516	3461	3230	+82.9
Barley	1013	1339	1475	1528	1784	1980	+95.5
Oats	2427	3399	3951	4133	3678	3684	+51.8
Mixed Corn	85	262	544	546	501	426	+401.2
Rye	18	22	51	70	135	125	+594.4
Total Grain ..	**5308**	**6832**	**8285**	**8793**	**9558**	**9446**	**+78.0**
Beans, for stock feeding (b)	135	91	195	223	249	289	+114.1
Peas, for stockfeeding (b)	37	39	64	69	65	58	+56.8
Potatoes	704	832	1123	1304	1391	1421	+101.8
Turnips and Swedes, for fodder	(c)727	(c)763	837	858	830	827	+13.8
Mangolds	216	231	267	269	286	309	+43.1
Sugar beet	345	329	351	425	417	434	+25.8
Rape	65	87	118	154	167	185	+184.6
Cabbage, Kale, Savoys, and Kohlrabi, for fodder (d) ..	107	132	214	201	214	221	+106.5
Vetches (e)	53	41	64	69	79	78	+47.2
Lucerne	32	31	28	32	(f)	(f)	
Mustard, for seed ..	24	24	17	22	16	12	—50.0
Mustard, for fodder or ploughing in ..	24	30	28	27	30	29	+20.8
Flax, for fibre or linseed	26	77	157	148	161	200	+669.2
Hops	19	19	18	18	19	20	+5.3
Fruit (g)	301	300	310	302	301	299	—0.7
Vegetables for human consumption (excluding potatoes), Flowers and Crops under Glass (h) ..	280	282	349	385	375	466	+66.4
All Other Crops ..	37	41	71	89	105	92	+148.6
Bare Fallow	374	306	219	280	240	231	—38.2
Total Crops and Fallow (Tillage) ..	**8813**	**10486**	**12714**	**13666**	**14502**	**14617**	**+65.9**

(*continued opposite*)

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
Clover, Sainfoin and Temporary Grasses for mowing ..	1902	1909	1749	2102	2332	2490	+30.9
Clover, Sainfoin and Temporary Grasses for grazing ..	2191	1951	1777	1729	1885	2263	+3.3
Total Temp. Grasses	**4093**	**3859**	**3526**	**3831**	**4217**	**4752**	**+16.1**
TOTAL ARABLE LAND	**12906**	**14346**	**16240**	**17497**	**18719**	**19369**	**+50.1**
Perm. Grass for mowing	5009	4619	4082	3533	2989	2615	—47.8
Perm. Grass for grazing	13764	12465	11032	10173	9330	9083	—34.0
Total Permanent GRASS	**18773**	**17084**	**15114**	**13706**	**12319**	**11698**	**—37.7**
TOTAL ACREAGE OF CROPS AND GRASS EXCLUDING ROUGH GRAZINGS ..	**31679**	**31430**	**31353**	**31204**	**31038**	**31068**	**—1.9**
Rough Grazings ..	16539	16639	17003	16959	17117	17172	+3.8

(a) Each individual acreage figure is rounded to the nearest thousand acres.
(b) Includes acreage grown for human consumption in Northern Ireland.
(c) Includes acreage grown for human consumption in England and Wales.
(d) Includes acreage grown for human consumption in Scotland and Northern Ireland.
(e) Includes mashlum for threshing as grain in Scotland.
(f) Included under Temporary Grasses.
(g) Includes acreage of small fruit only in Scotland, where the orchard acreage is returned under the crops growing beneath the trees.
(h) In Scotland and Northern Ireland, acreage of vegetables only. Includes peas harvested dry.

II. ESTIMATED PRODUCTION OF THE PRINCIPAL CROPS IN THE UNITED KINGDOM 1936-8 AND 1939-44

(*thousand tons*) (a)

Description	1936-8	1939	1940	1941	1942	1943	1944 (Preliminary Forecast)
Wheat	1651	1645	1641	2018	2567	3449	3142
Barley	765	892	1104	1144	1446	1641	1749
Oats	1940	2003	2892	3246	3553	3059	3051
Mixed Corn	76	73	226	438	463	394	352
Rye (for threshing)..	10	10	11	26	45	95	90
Total Grain ..	**4442**	**4623**	**5874**	**6872**	**8074**	**8638**	**8384**
Sugar Beet	2741	3529	3176	3226	3924	3760	3873
Potatoes	4873	5216	6404	8010	9393	9822	9859
Turnips and Swedes, for fodder	10994	10100	10815	12026	13224	11991	11627
Mangolds	4082	4069	4219	5107	5426	5805	5459
Seeds Hay	2676	2586	2652	2451	3057	3435	3250
Meadow Hay ..	4999	5203	4358	4175	3604	3238	2385
Total Hay	**7674**	**7789**	**7010**	**6626**	**6661**	**6673**	**5635**

(a) Each individual production item is rounded to the nearest thousand.

III. LIVESTOCK POPULATION

June 4 Agricultural Returns, United Kingdom, each year from 1939 to 1944

(*thousand*) (a)

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
Cows and heifers in milk	2841	2849	2878	2809	2910	2931	+3.2
Cows in calf but not in milk	480	488	524	588	640	651	+35.6
Total	**3321**	**3337**	**3402**	**3398**	**3550**	**3582**	**+7.9**
Heifers in calf ..	564	621	586	802	774	795	+41.0
Bulls for service ..	114	115	115	125	131	133	+16.7
Other cattle two years old and above:							
Male	(b)	(b)	(b)	(b)	(b)	691	
Female	(b)	(b)	(b)	(b)	(b)	668	
Total	**1229**	**1301**	**1167**	**1214**	**1226**	**1359**	**+10.6**
Other cattle one year old and under two:							
Male	(b)	(b)	(b)	(b)	(b)	523	
Female	(b)	(b)	(b)	(b)	(b)	1262	
Total	**1867**	**1857**	**1893**	**1693**	**1726**	**1785**	**—4.4**
Other cattle under one year old:							
Male	(b)	(b)	(b)	(b)	(b)	581	
Females	(b)	(b)	(b)	(b)	(b)	1310	
Total	**1778**	**1863**	**1777**	**1844**	**1853**	**1891**	**+6.4**
TOTAL CATTLE..	**8872**	**9093**	**8940**	**9075**	**9259**	**9546**	**+7.6**
Sheep over one year old:							
Rams for service ..	317	310	260	256	247	249	—25.1
Ewes for breeding	10975	10687	9229	8852	8201	8165	—25.6
Two-tooth (shearling) ewes (c) ..	2240	2216	1859	1769	1977	2121	—5.3
Other sheep over one year old ..	1254	1568	1620	1273	1192	1170	—6.7
Total over one year old	**14786**	**14782**	**12967**	**12150**	**11617**	**11706**	**—20.8**
Total under one year old	**12102**	**11537**	**9290**	**9356**	**8766**	**8635**	**—28.6**
TOTAL SHEEP AND LAMBS ..	**26887**	**26319**	**22257**	**21506**	**20383**	**20340**	**—24.4**

(*continued opposite*)

(a) Each individual livestock item is rounded to the nearest thousand.
(b) Not separately returned.
(c) Not separately returned in Northern Ireland.

Description	1939	1940	1941	1942	1943	1944 (Preliminary)	Percentage change 1944 on 1939
TOTAL SOWS FOR BREEDING ..	**542**	**468**	**244**	**250**	**186**	**252**	**—53.5**
Boars for service ..	34	32	18	19	15	21	—38.2
All other Pigs:							
Over 5 months ..	767	919	711	612	614	520	—32.2
2–5 months ..	1872	1778	1114	812	667	667	—64.4
Under 2 months ..	1179	909	469	451	347	415	—64.8
TOTAL PIGS ..	**4394**	**4106**	**2558**	**2143**	**1829**	**1875**	**—57.3**
Fowls over 6 months old	31039	33880	35647	27104	23346	23397	—24.6
Fowls under 6 months old	38491	32874	22436	26398	23025	26904	—30.1
Total	**69530**	**66754**	**58083**	**53502**	**46371**	**50301**	**—27.7**
Total Ducks ..	**2882**	**2660**	**2326**	**2645**	**2640**	**3004**	**+4.2**
Total Geese ..	**715**	**711**	**734**	**766**	**821**	**905**	**+26.6**
Total Turkeys ..	**1230**	**1118**	**916**	**901**	**896**	**995**	**—19.1**
TOTAL POULTRY	**74357**	**71243**	**62059**	**57813**	**50729**	**55206**	**—25.8**
Horses used for agricultural purposes (including mares kept for breeding) ..	724	719	747	664	693	658	—9.1
Unbroken horses of one year old and above	139	134	121	111	94	92	—33.8
Light horses under one year old / Heavy horses under one year old	62	54	46	42	40	38	—38.7
Stallions being used for service in the current year ..	5	4	4	4	4	3	—40.0
All other horses (not entered above) ..	148	139	137	186	126	127	—14.2
TOTAL HORSES ..	**1079**	**1050**	**1054**	**1006**	**957**	**918**	**—14.9**

(a) Each individual livestock item is rounded to the nearest thousand.
(b) Not separately returned.
(c) Not separately returned in Northern Ireland.

TRIALS OF POTATOES FOR IMMUNITY FROM WART DISEASE

THE official trials of new varieties of potatoes for immunity from Wart disease conducted by the Ministry of Agriculture and Fisheries in collaboration with the Department of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland have been continued during the period of the war, and as a result six new varieties have been added to the list of approved immune varieties. Descriptions of these are given below.

A short list of the more commonly grown varieties which are approved as immune from Wart Disease may be obtained on application to the Ministry at Berri Court Hotel, St. Annes-on-Sea, Lancs.

SIX NEW VARIETIES

EARLY VARIETIES

Home Guard

SPROUT	Blue.
TUBER	Oval; skin white; flesh white; eyes shallow.
HAULM AND FOLIAGE	Medium height, open; stems fairly numerous and thin, coloured at nodes and base; wings straight; leaf rigid, fairly open, medium green and waxy; leaflets small, flat and pointed, soft appearance, dark green in colour; secondary leaflets fairly large.
FLOWERS	White, buds pink at base.

Strathearn Early

SPROUT	Pink.
TUBER	Kidney; skin white with pink blush; flesh white tinged lemon; eyes shallow.
HAULM AND FOLIAGE	Low growing, spreading type, weak; medium green; long drooping leaf; leaflets long and narrow, glossy and slightly wrinkled; secondaries small; slight pink tinge on stems extending into mid rib of leaf.
FLOWERS	Large deep red-purple, numerous; deep orange anthers; dark hairy buds; slender stalks.

EARLY MAINCROP VARIETIES

Stormont Dawn

SPROUT	Pink, colouring very faint.
TUBER	Thick kidney; skin white; flesh white; eyes medium.
HAULM AND FOLIAGE	Medium to tall; stems strong and straight; wings broad and waved; habit compact and close; leaf open; mid rib of leaf tinged lemon; leaflets medium sized, roundish, slightly fluted, thick, dull and grey green in colour.
FLOWERS	White, freely formed.

Ulster Cromlech

SPROUT	Purple.
TUBER	Thick oval; skin white; flesh white; eyes shallow.
HAULM AND FOLIAGE	Straight, medium height, stems strong and free from branching, purple markings on stem; wings medium and waved; leaf long, arched, close, smooth, large sized, soft and light green in colour, purple markings on mid rib of leaf at base of leaflets stalk; leaflets light green, secondary leaflets rather small.
FLOWERS	White, freely formed; buds large; flower stalk medium length.

Dr. McIntosh

SPROUT	Pink.
TUBER	Long kidney; skin white; flesh white; eyes shallow.
HAULM AND FOLIAGE	Growth strong, medium to low compact bushy plants making good cover; colour dark green; long close leaf; oblong leaflets slightly cupped, glossy; secondary leaflets pointing upwards, numerous and of medium size; wings crinkled; stems with slight bronzing only.
FLOWERS	Numerous clusters of white flowers with large deep orange anthers; long stalks; sets large berries.

Ulster Earl

Sprout	Pink.
Tuber	Oval; skin white, flesh white and soft; eyes shallow.
Haulm and Foliage	Medium to tall stems, very strong and branching; colour dark green; wings double, broad and very much waved; spreading bushy habit; leaf medium to close; leaflets thick, medium-sized and rounded, grey-green in colour; secondaries numerous and small.
Flowers	White and profuse; stalks thick; buds deep pink pointing upwards.

OFFICIALLY APPROVED INSECTICIDES AND FUNGICIDES

Since the date of the list published in the July, 1944 issue of this JOURNAL (p. 190) the following have been added to the list of proprietary products officially approved for the control of plant pests and diseases.

GROUP A: LEAD ARSENATE POWDERS

Corfe's Arsenate of Lead Powder	Corfe & Son Ltd.	A 111

GROUP B: LEAD ARSENATE PASTES

Corfe's Arsenate of Lead Paste 15% As_2O_5 **Corfe's Arsenate of Lead Paste 20% As_2O_5**	Corfe & Son Ltd.	B 112

GROUP C: LIME SULPHUR WASHES

Corfe's Lime Sulphur	Corfe & Son Ltd.	C 113

GROUP D: MISCIBLE TAR OIL WINTER WASHES

Kilcrobe Miscible Tar Oil Winter Wash	Hull Chemical Works Ltd.	D 110
Monro's Miscible Tar Oil Winter Wash	Geo. Monro Ltd.	D 109
Pearson's Miscible Tar Oil Winter Wash	Pearson's Antiseptic Co. Ltd.	D 108

GROUP E: STOCK EMULSION TAR OIL WINTER WASHES

Killgerm Stock Emulsion Tar Oil Winter Wash	The Killgerm Co. Ltd.	E 104

GROUP G: DERRIS AND LONCHOCARPUS INSECTICIDES, TO BE USED AS DUSTS

Drymac Derris Dust	Plant Protection Ltd.	G 84
Drymac No. 2	Plant Protection Ltd.	G 77
I.T.P. Derris Dusting Powder (Heavy Grade)	International Toxin Products Ltd.	G 100
I.T.P. Derris Dusting Powder (Light Grade)	International Toxin Products Ltd.	G 99
Monro's Lonchocarpus Heavy Dust	Geo. Monro Ltd.	G 86
Monro's Lonchocarpus Light Dust	Geo. Monro Ltd.	G 85
Monrose Flea Beetle Dust	Geo. Monro Ltd.	G 87
Wee-Bee 40	W. J. Craven & Co. Ltd.	G 91
Wee-Bee 41	W. J. Craven & Co. Ltd.	G 80

OFFICIALLY APPROVED INSECTICIDES AND FUNGICIDES

GROUP H: DERRIS AND LONCHOCARPUS INSECTICIDES, TO BE USED AS SPRAYS

Abol Liquid Derris Insecticide	Plant Protection Ltd.	H 79
Dactine	W. J. Craven & Co. Ltd.	H 81
Katakilla	Plant Protection Ltd.	H 82

GROUP J: COPPER FUNGICIDES (EXCLUSIVE OF SEED DRESSINGS), TO BE USED AS DUSTS

The chief crops for which the products are recommended are given in brackets; the labels of the products give full uses and instructions.

Cupryl Copper Dust (*hop, celery, apple and pear*)	W. J. Craven & Co. Ltd.	J 103
McDougall's Dry Bordeaux Powder (*hop*)	Plant Protection Ltd.	J 88
Perelan 1 (*potato*)	Plant Protection Ltd.	J 98
P.P. Potato Fungicide (*potato*)	Plant Protection Ltd.	J 89

GROUP K: COPPER FUNGICIDES (EXCLUSIVE OF SEED DRESSINGS), TO BE USED AS SPRAYS

The chief crops for which the products are recommended are given in brackets; the labels of the products give full uses and instructions.

Abol Cheshunt Compound (*for damping-off diseases only*)	Plant Protection Ltd.	K 90
Berk's Sprayable Cuprous Oxide (*potato, tomato*)	F. W. Berk & Co. Ltd.	K 93
Hemway Copper Oxychloride	Hemingway & Co. Ltd.	K 95
Perenox (*potato, tomato, hop, celery*)	Plant Protection Ltd.	K 97
Seo (*potato, tomato*)	Geo. Monro Ltd.	K 94

There are no additions to be made to the list of approved organo-mercury dry seed dressings published in previous issues. Further applications for approval in all the above groups, and for the approval of copper sulphate, are invited.

It should be clearly understood that products in groups other than those named above have not yet become eligible for consideration under the scheme.

A complete list of the proprietary products so far approved in any of the above groups may be obtained on application to the Secretary of the Advisory Committee at the address given below.

Ministry of Agriculture and Fisheries,
Plant Pathology Laboratory,
Milton Road,
Harpenden, Herts.

October 13, 1944.

3226/10 Wt. 18 11/44 CN&Co. 466

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WAR-TIME FARMING IN NORTHERN IRELAND

J. A. YOUNG, B.Agr.

Ministry of Agriculture, Northern Ireland

THE land in Northern Ireland consists of a wide variety of soil types interspersed in small pockets throughout the six counties. Soils vary from the almost pure sand of Magilligan in North Londonderry to the extreme heavy clays of South Antrim; from the warm, dry loams of the Ards Peninsula to the cold, wet soils of County Fermanagh, and from the rich alluvial soils of County Armagh to the poor high-lying mountain land of North Tyrone. Good and bad land are to be found side by side nearly everywhere throughout the Province.

Generally speaking, the climate is wetter than in England, the average annual rainfall being about 35 inches distributed over 210 days in the year. This makes the saving of hay, corn and flax crops both uncertain and difficult, and it means that weeds are an unending plague in land under the plough. So far as grassland is concerned, the high rainfall generally ensures good hay crops and luscious pastures, but with rotation grazing on the heavier soils there is always the difficulty of avoiding cattle poaching the land in wet weather.

The farms in Northern Ireland differ from those in Great Britain in that their average size is considerably smaller and, as a result of the Irish Land Acts, that they are owner-occupied. In Northern Ireland 100 acres is regarded as a large farm, nearly half the country being composed of holdings under 50 acres. This, together with the fact that Northern Ireland farmers have a considerable proportion of their capital locked up

in the purchase price of their land, tends to handicap progress; nevertheless, great strides have been made in farming methods in recent years. As owners of their farms, the majority of farmers take a genuine pride in maintaining, and if possible increasing, soil fertility.

A Typical Farm before the War Perhaps the most outstanding feature of Northern Ireland farming is the fact that by far the greater proportion of the farmers' income comes from the sale of live stock and livestock products. In peace time the proportion of farm income derived from this source was about 85 per cent., but at present it is not as high, due largely to an increase in direct crop sales, mainly of flax and potatoes, and a large reduction in pig feeding since the outbreak of war; nevertheless, the economy of Northern Ireland farming is still bound up with the principle of cashing arable crops, as well as grain indirectly through live stock.

Excluding those farmers situated conveniently to Belfast and the larger towns, men who specialized in milk production or vegetable-growing, the typical system of farming in peace time was to keep about 25 per cent. of the ploughable land under the plough and to feed the produce, along with imported feedingstuffs, to live stock on the farm. The live stock in turn made farmyard manure which, when returned to the land, constituted the basis of maintaining soil fertility. The live stock on a normal 50-acre farm consisted generally of 5 or 6 cows (the milk being sent to a local creamery), 5 or 6 young calves, and 5–10 other cattle ranging from bulling heifers to fattening bullocks, as well as 8–10 breeding ewes, 100 or more poultry, and a number of pigs varying between 10 and 200. On farms where more than about 30 pigs were kept their food consisted almost entirely of imported feedingstuffs, but on farms with small numbers a mixture of boiled potatoes, ground oats, maize meal and separated milk was the common ration. Only limited quantities of imported feedingstuffs were purchased for the cattle and poultry; for the most part these classes of stock were fed on farm produce.

The crop rotation generally adopted was: oats—potatoes or roots—oats—hay (seed, mostly saved)—grazing for 3 to 10 years. Wheat and barley were rarely grown. Flax was grown on a limited scale, mainly in Counties Antrim, Derry, and Down. In some districts the flax was grown after lea oats in the rotation, and in others it came after the second oat crop, being used as a nurse crop for the grass and clover seeds. First year hay was generally saved for seed, and in this connexion it is noteworthy that for many years Northern Ireland has been the world's chief producer of ryegrass seed. Potatoes, flax and grass seed were the main cash crops; few farmers sold any of their oats, and in most districts a large proportion of the potatoes grown was fed to farm stock.

Increased Food and Flax No Northern Ireland farmer is likely to forget the first winter of the war. Feedingstuffs quickly became scarce, and farmers were naturally loth to reduce the numbers of their stock. But the facts had to be faced, and pigs, the stock most dependent on imported feedingstuffs, were drastically reduced that winter, many half-finished animals going for slaughter. However, this sudden and severe shortage of feedingstuffs impressed the farmers, more strongly than anything else could have done, with the need to make their farms self-sufficient during war time and, together with the national appeal for the production of more food for direct human consumption, gave impetus to the plough.

Taking the country as a whole, the proportion of the ploughable land under tillage has increased from 25 per cent. in 1939 to about 45 per cent. in 1943, when the maximum was reached. That every farmer contributed his share to this increase was ensured by successive compulsory tillage Orders made by the Ministry of Agriculture. In making these Orders the Ministry took special consideration of the fact that many farmers had given up arable cropping entirely and thus they could not easily return immediately to large-scale tillage farming. Accordingly the Orders were so framed as to obtain an increase each year from those farmers who had never given up the use of the plough, and at the same time to raise the proportion of tillage on the grass farms gradually to the same level. The results achieved are shown in the following Table :

YEAR	1939	1940	1941	1942	1943	1944
Area of tillage Crops (*thousand acres*)	471	660	798	828	851	840
Percentage increase over 1939	--	40	69	76	81	78

The increase in the tillage area has not resulted in any drastic changes in the cropping system. The crop rotation already given for peace time still forms the hub around which the increased cropping revolves, although flax is now a regular feature of it on many more farms. The area of flax grown in 1944 was over 124,000 acres, compared with 21,000 acres in 1939. By dam retting on the farms the greater proportion of their flax, Northern Ireland farmers have fulfilled a particularly useful purpose, as dam-retted fibre, unobtainable from other sources, is required for much of the better quality articles for which fibre from green flax is unsuitable.

Oats, which occupies a greater area than any other two crops together, is still the principal cereal crop and, as in peace time, by far the greater proportion of this crop is fed to stock on the farms. In the first year of the war barley showed over 400 per cent. increase in area, reflecting a desire by many farmers to try to maintain the pig population. But that first year's increase in barley has hardly been maintained because (1) the soils and climate did not prove particularly suitable for the crop, and (2) it is not permissible to use barley of good quality as a food for stock. The same remarks apply in general to wheat. But the areas under these crops are negligible compared with those under oats.

The wet climate of Northern Ireland makes it essential for every good farmer to grow a cleaning crop at least once in each crop rotation if weeds are to be kept under control. For the same reason it is generally considered bad farming to take more than two straw crops in successive years. In fact, in peace time the majority of farmers never took more than one straw crop without following it with a cleaning crop. Potatoes have always been and still are the principal cleaning crop ; they occupy over six times as much ground as all other green crops put together. The main reasons for this are that potatoes seldom fail and are more satisfactory as a cleaning crop than turnips and mangolds. Therefore, they largely took the place of these crops for winter feeding.

Another factor which has contributed to the increase in the potato acreage in recent years has been the development of the trade in seed potatoes. Indeed, many farmers are now catering mainly for the seed trade ; they consider the growing of potatoes for sale on the ware market to be an uneconomical proposition. The climate of Northern Ireland is particularly favourable for the production of healthy crops of potatoes free from virus diseases, and the good results obtained from the seed already shipped have meant that the increase in the quantity available for shipment each year has not been able to keep pace with the demand. The quantity shipped last year broke all previous records, and it is expected that a further record will be set up this season.

The question of seed potato production is taken very seriously in Northern Ireland by farmers and the Ministry of Agriculture alike. In the first place intending seed producers plant only seed from pure healthy crops which have been certified the previous year, while, at regular intervals, they renew their stocks by purchasing seed from "stock seed" crops specially selected by the Ministry. All crops intended for the seed trade are inspected during the growing season by officers of the Ministry, and only those up to the specified standards of health and purity are certified. Nothing but the produce of certified crops is allowed to be shipped as seed.

Spraying with Burgundy mixture to keep Blight off the tops is a routine practice. Generally two sprayings are applied, but in wet seasons main crops are often sprayed a third time. The aim is to keep the tops completely free from Blight until the crop reaches the stage when the bulk of tubers are of the regulation seed size. At that stage the common practice of seed growers is to kill the tops by spraying with a mixture of copper sulphate and sulphuric acid in water. This prevents further growth and at the same time ensures that there are no tops left for Blight to infect. This reduces to negligible proportions the possibility of Blight infecting the tubers and causing rotting during storage.

The crop is ready for lifting in from 10 to 14 days after the killing of the tops—a period which allows time for the skin of the tubers to harden. Finally, before shipment all consignments of seed are inspected and the bags sealed on the farms by officers of the Ministry to ensure that they have been properly picked and graded.

Equipment and Labour At the outbreak of war the task of increasing the area of land under the plough seemed almost insuperable to many farmers. The demand for labour for the making of munitions and for other war industries accelerated the drift from the land which had gradually been gathering momentum for years. Farmers found themselves being asked to grow more crops with less labour. In these circumstances they became tractor-minded almost overnight, and the demand for tractors and tractor machinery became far greater than the supply.

At this stage the Ministry of Agriculture took control of the distribution of all tractors, the aim being to ensure that each new tractor went to the district most in need of it. The Ministry also established a hire purchase scheme for tractors, so that lack of capital was no obstacle to the farmer greatly in need of one. There were not nearly enough tractors to go round during that first year or two, and it was obligatory on those who had tractors to keep them working full time in so far as the weather permitted. This meant that almost every tractor owner, except the larger farmers, became a tillage contractor in a small way during the first few years of the

war. There are now 12 times as many tractors in the country as in 1939, and there has been a proportionate increase in the use of tractor implements and machinery.

The greatly increased use of machinery was not sufficient in itself, however, to solve the harvest problem. Corn crops are frequently lodged and incapable of being cut with the binder and, to make matters worse, good harvest weather can seldom be expected for more than a few days at a time. Harvesting in Northern Ireland is largely a question of making a supreme effort on every good day in the almost certain knowledge that it will be raining before long. During the harvests of 1940 and 1941 farmers managed to get through with their normal staff plus whatever casual help they could muster locally. For the increased harvest of 1942, however, the Ministry of Agriculture organized a Voluntary Land Service Scheme, whereby the help of volunteers from all walks of life was placed at the disposal of farmers. The volunteers were transported to and from the farms each day in government vehicles. This scheme has been continued ever since, and in 1943 and 1944 it was supplemented by a Gang Labour Scheme. Briefly, the essence of the latter scheme is that unemployed industrial workers were asked to volunteer for harvest work, organized into gangs and transported from their local Labour Exchanges to farms each day. Both these Harvest Labour Schemes have served a useful purpose, and it is partly to the credit of these volunteer workers that the two greatest harvests in living memory (1943 and 1944) have been saved without appreciable loss.

Live Stock As already mentioned, excluding those farmers living near larger towns who specialized in milk production, nearly every general farmer kept a few cows and sent milk to a local co-operative creamery for manufacture into butter. Two-thirds of the total milk produced in the country went for manufacture—mainly butter. The price received for it was 5d. per gallon in the summer and 6½d. in the winter ; the separated milk was returned to the farm. In addition, a bonus of 2d. per gallon was payable to those holding Grade C milk licences. People may now wonder why farmers continued to produce milk at those prices, but the reason is not far to seek. In the first place Northern Ireland was a cattle-raising country, and cattle could not be raised without cows. Thus milk was only one of two reasons for keeping cows. Secondly, the cost of milk production was kept at a minimum by arranging that the cows calved in spring and early summer, and thus were in full milk during the grazing season. Winter milk production was negligible on farms supplying milk to creameries. Thirdly, the fact that the separated milk was returned fitted in well with the system of farming. Being rich in protein and minerals, the separated milk was exactly what was wanted to balance the starchy home-produced foods for the feeding of calves, pigs and poultry—all of which could be found on the average farm.

Since the outbreak of war the position has changed entirely. The Ministry of Agriculture is now the sole purchaser of milk from the producer, and arrangements are in operation whereby milk in all parts of the country is collected and taken to depots set up and equipped by the Ministry. All milk up to a certain standard of quality fetches the fixed price for liquid milk irrespective of the purpose for which the milk may be used. Thus the farmer in an outlying district can now compete on almost equal terms with the farmer living near one of the larger towns. The result is that farmers all over the country have gradually increased the number of cows kept, and they have also partially switched over from summer to winter milk production, so as to take advantage of the higher prices for the latter.

The number of cows in Northern Ireland at June 1 this year showed an increase of almost 18 per cent. over the corresponding figure for 1939, while the number of in-calf heifers was over 100 per cent. greater than in 1939. The total number of cattle of all types shows almost 18 per cent. increase over that of 1939, despite the fact that the grazing area is now considerably less than it was then. Even allowing for the 24 per cent. decrease in the sheep population, this means that the stock-carrying capacity of pastures now is much greater than it was before the war. Although the fattening of cattle on grass is still pursued on a considerable scale, winter fattening has declined. The view of farmers on this point is that it pays better to feed cows for milk in winter than to produce beef. The majority of cattle are kept housed at night during the winter months, while cows and fattening cattle are generally housed night and day. This policy has two aims: (1) to avoid poaching of the land; and (2) to ensure making the maximum quantity of farmyard manure.

As already mentioned the sheep population has fallen by slightly over 24 per cent. since 1939. This reduction has been influenced by the desire to keep more cows in the belief that milk production is more profitable than keeping sheep. The Blackface is by far the commonest breed of sheep and occupies all the hill land in the country, in addition to many lowland farms. The common practice on the lowland farms is either to buy a few hill lambs in autumn for fattening or to keep a few Blackface or cross-bred breeding ewes. The Blackface ewes are mated with a Border-Leicester ram, and the cross-bred ewes either with a Border-Leicester or Suffolk. General farmers do not normally keep large flocks of sheep—usually just one sheep to two or three acres. Thus on general farms sheep are treated merely as a sideline, the belief being that better returns can be obtained from pastures by running a few sheep with the cattle than by grazing with cattle alone.

Perhaps the most severe blow of the war has been the drastic and sudden reduction which had to be imposed on pig-keeping—an industry which had been expanding rapidly since the introduction of controlled marketing under the Pigs Marketing Board in 1933. The present tendency is for the pig population to continue falling, and the view of farmers is that no appreciable increase can be expected so long as imported feeding-stuffs are unavailable. Apart from a small allowance of rationed feeding-stuffs, oats, chat potatoes, roots and greens are practically the only foods now available for pig feeding, and an ideal fattening ration cannot be made up from these.

The poultry position in Northern Ireland contrasts very sharply with that in Great Britain. In Northern Ireland the numbers of poultry have increased very considerably since the outbreak of war, whereas in Great Britain poultry have suffered the same fate as pigs. Several factors have contributed to this state of affairs. In the first place the greater part of the poultry of Northern Ireland has always been kept on free range on the general farm. This meant that since the first difficult winter of war ample home-grown foods have been available. Secondly, unlike the requirements of pigs, the home-grown foods that were produced (oats, greens and chat potatoes) proved very satisfactory for poultry feeding when used in conjunction with a small proportion of rationed feedingstuffs. A third point favouring poultry in preference to pigs was that farmers generally regarded the price of eggs as being controlled at a more profitable level than the price of pigs.

The commonest system of poultry-keeping in Northern Ireland is to run the birds in portable houses on free grass range, following the plough round the farm. This system makes for healthy, vigorous birds and so

far has proved very successful. Typical war-time poultry feeding is from half to three-quarters of the birds' food requirements in the form of whole oats and the remainder in the form of a wet mash made up of ground oats and boiled chat potatoes with some rationed meals, including a proportion of protein meal if available. Excellent results are being obtained from this very simple system of feeding.

Outlook for the Future Northern Ireland farmers have vivid memories of the plight in which farming found itself after the last war, and for this reason many are sceptical as to the prospects for farmers after this war; few are confident enough to make long-term plans. It is probable, however, that the basic principle which has characterized Northern Ireland agriculture for so long will continue—namely, the disposal of the greater proportion of the arable crops by feeding them to stock on the farm, but if the demand for seed potatoes continues to increase as expected, a gradually decreasing proportion of the potato crop will be used for stock feeding.

Many farmers would like to plan for a return to large-scale pig feeding, but up to the present official pronouncements have tended to discourage this idea. Apart, therefore, from maintaining a skeleton stock of good breeding pigs, farmers are afraid to commit themselves in this direction. There is little doubt that the raising of store and beef cattle will continue to hold an important place, but at present the products for which farmers see the best prospects are milk, eggs and seed potatoes. It is in these products that the greatest increase is expected during the next few years.

SUGAR BEET AND THE DAIRY HERD

C. Wharton

Stokesby, Great Yarmouth

FOR a number of years I have regarded sugar beet and milk as the axis of my farming system. Both have the advantage of a contract price, and fit in together extremely well. When I began farming on my own account in 1929 sugar beet covered about 10 acres, and the yields (by reason of my lack of knowledge) were very low—in fact, no more than 7 tons per acre. I had, therefore, to get down to the job of growing sugar beet successfully, and after ascertaining the extent to which my land was deficient in lime and phosphate, I adopted a programme of cultivation, liming and manuring, which has been amply justified. Now my acreage has increased to approximately 120, and during the last few years the average yield of washed beet has varied between 11 and 15 tons per acre.

I have always believed in keeping as large a head of stock as possible for the benefit of the farm, but I also believe in keeping as much of my land as possible under the plough—preferably sown with cash crops—so that while normally I carry between 350 and 400 head of horned stock throughout the year, I do so with much less than one acre of grass per head. Unmarketable by-products from the arable land form the bulk of the winter feeding, and very little acreage is devoted to the growing of crops for feeding to stock direct.

My cropping for 700 acres of arable for this year and the programme for next are as follows:

1944 Acres	1944 Crop	1945 Acres	1945 Crop
140	Wheat	120	Wheat
140	Barley	100	Barley
50	Oats	50	Oats
20	Peas or Beans	20	Peas or Beans
40	Hay from 1-year leys	56	Hay from 1-year leys
52	Potatoes	82	Potatoes
128	Sugar beet	128	Sugar beet
12	Kale	12	Kale
14	Vegetables	18	Vegetables
6	Mangolds	6	Mangolds
98	Reseeded	108	Reseeded

This cropping naturally reflects war-time requirements, but actually differs very little from my peace-time programme, except that I now have to grow more protein in the form of peas or beans instead of buying it from the cake merchant. The grassland consists mainly of reseeded pastures. In fact, with the exception of a block of 118 acres of marshes, three miles from home, every acre of grassland attached to my farm has been ploughed and either brought into arable cropping or reseeded. This has involved an extensive reclamation scheme covering 150 acres of previously low meadows, rush-infested and fit only for rough grazing. This area now carries some of my best pastures and some of my heaviest cropping arable land.

The Dairy Herd My usual head of stock (350–400) includes approximately 150 dairy cows in milk. Previously these were run as one large unit, hand milked and wintered outside. During the last few years I have split the herd into two units, and each is milked by machine. One of these herds is now Tuberculin Tested and milked by an Auto-Recorder unit. Housing is provided by yards which were previously devoted to bullock fattening.

The second herd will be replaced by a batch of Tuberculin-Tested heifers, so that in time all stock will be Tuberculin Tested.

Normally I rear all the heifers for herd replacement, but as the herds are now Ayrshire and Friesian respectively, I am unable to provide my own beef stores—for I still keep an interest in beef production at "off" sets of premises. An expansion of the herd and the greater need for isolation with the Tuberculin-Tested stock will probably mean the end of beef production for the time being. After all, it was only a traditional liking for the bullock that encouraged me to keep any in recent years: it certainly was not for their cash profit!

In the general management of the dairy herd I have always endeavoured to feed the greater part of the bulky root ration on some dry pastures, or on the one-year ley hay stubble, so as to keep work in the sheds as light as possible. During the summer grazing period the cows have to rely very largely on grass until July; concentrates are given only to the highest yielders. The marshes are, of course, much more productive in our dry climate than upland pastures; without them, I should certainly find it necessary in the late summer to supplement with arable crops. However, this is largely avoided by:

(a) grazing the aftermath (if any) of the one-year leys cut for hay;
(b) using dried sugar-beet pulp, kept in reserve to offset a possible shortage of grass at this time of the year.

These two expedients usually enable me to carry through the summer successfully, but in a dry season, such as we have had this year, I am desperately short of feed in late summer.

Winter Feeding For the winter feeding period I rely very largely on the beet crop for the five months October to February, and in this way I manage to carry all my stock through the winter with a mere 18 acres of roots (12 of marrow-stem kale and 6 of mangolds). Usually I replace roots by sugar-beet by-products. The actual rations include what to some people might seem an extremely heavy allowance of roots or root-equivalent in the form of beet by-products ; on an average the allowance would not be less than 6 stones per head, per day. But at the same time, very little hay is grown for the cows, and what there is is reserved for the New Year.

Theoretically there is no difficulty in finding sufficient starch equivalent for maintenance and the first gallon of milk, but now that the supplies of cake which we used to get before the war are unobtainable, I have to dispense with a precautionary allowance of groundnut cake and rely on the protein contained in the beet tops and kale, and bring in peas or beans when we have to switch over to the lower protein mangolds and beet pulp

The feeding of concentrates according to yield is carried out as accurately as possible, and the success of the ration as a whole may be judged from the fact that I average approximately 9,000 gallons of milk per month from 150 cows throughout the winter.

When my cows were milked by hand or by the ordinary bucket-type of milking machine, all the roots were fed outside and the beet pulp (wet and dry) plus concentrates were fed in the mangers. With the Auto-Recorder I feed concentrates only during milking, except in summer, when each cow gets a bite of dried pulp to keep her happy.

Beet Tops I start lifting sugar beet in September, to get the tops for my cows early in the autumn. With a large acreage of beet it is also essential to make an early start to enable my normal labour staff to cope with the work, although I realize that I would get a greater weight of sugar by leaving the crop a little longer.

When lifting the crop I prefer to dig the beet by hand rather than use a lifting plough. Hand-digging costs very little more (about 10s. per acre extra), and the tops are kept much cleaner and therefore better for feeding. If possible the tops are left to wilt for about a week in the field before using. In the early part of the season (when we are also busy with potato lifting and wheat planting), the rate of using the tops practically keeps pace with the lifting of the crop, but later in the season, when every available man is put on the beet crop, we gain on the rate of feeding. I then like to heap up the tops in the field—small heaps about 2½–3 ft. in diameter and 2½–3 ft. high. This protects the tops from damage when carting off the beet and also assures a supply of tops safe to feed in periods of severe frost or snow. Also wastage is reduced, and the tops will keep safely in the heaps until the end of January.

During the war I have fed all the tops to live stock, but in pre-war days, when beet pulp was not restricted, I often left a proportion of the tops to plough in on certain distant fields, since they have a high manurial value—but in war time their feeding value is more important.

For feeding, the tops are carted on to the pastures where the cows eat them immediately *after* each milking. It is generally considered that a heavy ration of tops incurs a risk of taint to the milk, but by feeding them in the wilted condition and immediately *after* milking, I have had no trouble at all. Indeed, I should soon hear complaints from the retailers I supply if there were anything wrong. Up to Christmas the tops are fed

in conjunction with marrow-stem kale—one load of kale to two loads of tops. When these are fed together I find that the cows always prefer the beet tops and will clear them up before tackling the kale.

During the beet-lifting season all classes of dairy stock, down to calves of six months old, get the greater part of their root ration in the form of beet tops and thrive well on them.

In some years I have managed to ensile a small acreage of beet tops, using both concrete portable silos and clamps. At the moment of writing, with a heavy programme of autumn work on hand, I have neither the spare time nor the labour to make silage ; in fact, I find that I have only tops to spare when there is a good supply of beet pulp to feed right away. Nevertheless, I am satisfied from my own experience that surplus beet tops can be made into very useful silage, and hence a valuable reserve of fodder for the following spring and summer.

To prevent scouring when on beet tops I always take the precaution of feeding 2 oz. of chalk per cow, per day. This is mixed with the beet pulp and fed in the manger.

Wet Beet Tops As my farm is situated only ten miles from the nearest beet factory, I make full use of wet beet pulp. Its feeding value is good and, provided that the cost of carriage to the farm is not prohibitive, it can be a very valuable and relatively inexpensive food. At the present moment I am buying it at 11s. per ton, plus carriage. Its feeding value naturally varies with the moisture content, but trials at the Norfolk Agricultural Station show it to have more dry matter than mangolds and a slightly higher feeding value. In a normal year I should expect to get and use 500 tons of this wet pulp during the beet-lifting season.

The fresh wet pulp is very palatable, and I feed it in the troughs in the cowshed or in bins in the yard in the normal way, without adding any other food—even chaff. The cows and young stock eat it readily, and it has given no trouble.

In peace time I clamp a considerable tonnage of the wet pulp for use after the beet season has finished. There is no difficulty with clamping, provided the material is consolidated and earthed up to exclude air. The clamped pulp is fed in exactly the same way as the fresh pulp.

When fed alone as much as 70–80 lb. per day has been given to cattle, but when it is fed along with a liberal allowance of kale and beet tops, the wet pulp allowance is kept down to about 40 lb. per day.

Dried Beet Pulp The present allowance of dried beet pulp (1½ cwt. per ton of beet) is of fundamental importance to me as a beet grower and dairy farmer. As soon as the beet tops, kale and wet pulp are finished, I have to start on the dried pulp and mangolds. The dried pulp is a very convenient way of handling the equivalent of a root ration. I get my supplies from the factory, so that the bags are stacked in the barn until required. It is generally reckoned that 1 cwt. of dried beet pulp is equivalent to 7–8 cwt. of mangolds. I use the dried pulp mainly as a "root equivalent". For feeding in this way the pulp is soaked in 40-gallon tubs for 24 hours before feeding, and I allow 20 gallons of water to each bag of 1½ cwt. of pulp. When fed alone up to 8 or 10 lb. of pulp may be fed to each cow daily, but this is varied according to the quantity of roots available.

Dried pulp is also of use in the concentrated ration, but I find it rather bulky, and since I grow a substantial acreage of oats, I rarely need to call on the dried beet pulp as a concentrated starchy food.

One of the great advantages of dried pulp is that it can be stored safely throughout the year and against any emergency, such as a shortage of grass due to drought.

More Sugar : More Milk Under the system outlined in this article it has been possible for me to maintain my live stock and to reduce my acreage of roots for feeding to 18 (6 of mangolds and 12 of kale). This I consider to be particularly important in war time, as the extra sugar-beet acreage which I am able to carry yields that much extra sugar for human consumption, while the tops, together with the pulp, are adequate for the stock. Moreover, the sugar-beet crop brings in direct cash, and its by-products provide the food for the milking herd just when most required.

My only worry over this policy of feeding practically nothing but sugar beet tops over and above the rations allowed by the Feedingstuffs Officer is that I run the risk of reducing the fertility of my land by that amount of produce which goes off the farm in the shape of milk. I have, for instance, definite evidence that the potash content of the soil is on the decline, although during the past three years there has certainly been no fall in the yield per acre of the various crops grown. It is to be hoped that more potash fertilizer will be available soon. It might be argued that I could maintain my soil fertility at a higher level by the fattening of bullocks, but milk is priority food No. 1, and I feel that my system embraces sound farming practice.

CALF-REARING

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Worcestershire War Agricultural Executive Committee

THE foundation of livestock improvement is based on sound calf-rearing. The general tendency at the moment is to pay a lot of attention to the upgrading of dairy herds and the use of good, pedigree bulls with satisfactory milk and butter-fat records. Whilst it is admitted that good selective breeding is a means of securing an improved type of animal, no plan for livestock improvement can wholly succeed unless each animal is given a good start in life and reared under the best possible conditions. The normal development of many well-bred calves is often retarded and permanently affected by under-nourishment and bad housing in the early stages, with the result that the inherited conformation and productive potential is never fully attained. Good breeding must go hand in hand with good rearing, with particular emphasis on a dietary which will meet fully the nutritional requirements of the growing animal.

CALF-REARING

The essential points of good rearing may be stated briefly as under:

1. An adequate allowance of milk or its equivalent for the first 10–12 weeks.
2. The provision of good hay and some suitable concentrates after the first 2–3 weeks.
3. Scrupulous cleanliness of feeding utensils and housing accommodation.
4. Plenty of fresh air and exercise at all times.

Feeding Under natural conditions a cow would suckle her calf for a period probably exceeding six months. No one will deny that natural feeding gives the best results, but to follow such a system for rearing dairy-type calves would be uneconomic and impracticable. A substitute for natural rearing is to set aside one or two cows with sufficient milk to rear up to 6–8 calves each in the lactation period. Unfortunately it frequently happens that the type of cow used for this purpose has had udder troubles, such as mastitis, at some time or other, and the possibility of transmitting the disease organisms into the bloodstream of the calf must not be overlooked. It must also be borne in mind that an increasing proportion of the more efficient dairy herds is now officially milk recorded, and therefore it is necessary to remove the calf from the dam as soon as possible after birth in order to record the true yield of milk throughout the lactation period.

Taking these points into consideration, the most practical system to adopt on milk selling farms is pail feeding, using only as much whole milk as is necessary to ensure satisfactory growth. Excellent results can be obtained by this system, provided a few simple rules are followed.

The dam should be allowed to suckle her calf for the first 3–4 days (the colostrum period). Colostrum contains special tonic properties and is invaluable for building up disease-resisting powers. The feeding chart set out below is designed primarily to meet the requirements of heifer calves.

1st week	Colostrum for 3–4 days, then 3–4 quarts whole milk daily in three feeds.
2nd week	Give 4–5 quarts whole milk daily in three feeds. Introduce a little good hay at the end of the second week.
3rd, 4th and 5th weeks	3rd week—5 quarts milk daily in two feeds. Begin 4th week by giving 4 quarts whole milk with 1 quart gruel daily in two feeds. Gradually increase the proportion of gruel, ending 5th week with 3 quarts gruel and 1 quart whole milk in two feeds daily. At the end of the 3rd week introduce suitable dry concentrates of the "follow-on" type.
6th and 7th weeks	Give 4–5 quarts gruel daily in two feeds. Increase the allowance of concentrates to 1 lb. per calf daily and continue to offer a little good hay.
8th, 9th and 10th weeks	Gradually reduce the quantity of gruel and give clean water to drink, allowing up to 6 quarts of liquid daily. Increase the hay and concentrates as the gruel is decreased. Up to 2 lb. dry concentrates can be given daily.

After the 10th week the calves can be fed on suitable dry concentrates, good hay and clean water. A small allowance of green food or cut swedes and mangolds can be given from the third month onwards.

There are many proprietary milk substitutes on the market licensed as starter calf foods by the Ministry of Food. With some of the better types, it is necessary to add only 1 gallon of warm water to approximately 1 lb. of starter meal to produce a gruel mixture with a chemical analysis resembling whole milk; this type of starter can be relied upon to give satisfactory results. In all cases, however, the directions issued by the manufacturers should be followed closely.

Concentrates of the "follow-on" type are also available and are suitable for feeding calves from the 4th week onwards. Both starter and "follow-on" foods are obtainable against calf-food coupons only.

The first three months is the critical stage of a calf's life. After this period milk and milk substitutes can be replaced by concentrates, roots or green food, and good hay. Straw for feeding should be avoided until the animal is 18–20 months old. A suitable dry concentrated ration could be 3 parts crushed oats, 2 parts finely broken linseed cake, and 1 part white fish meal. Should it be impossible to obtain linseed cake, it can be replaced by the same percentage of bean meal, plus a small quantity of bran. White fish meal is a highly important food for calf-rearing, and when this is unobtainable the deficiency should be made good with another suitable high protein food or skim milk powder and 2 per cent. cod-liver oil rubbed into a little bran and well mixed into the ration.

In districts free from "husk" or "hoose" the calves should spend their first summer on good grazing pastures. Where this is not possible, they should be kept in a paddock or yard and fed on concentrates, etc., as indicated above.

Housing and Hygiene On many farms calves are overcrowded in dark, badly ventilated, and often damp buildings. Exercise is restricted, and after some months of such confinement it is not surprising that they have every appearance of immature scrub heifers. Calves very readily respond to good management, and if possible they should be housed in pairs or small lots in well-ventilated pens. The floor should be constructed of concrete and well littered with wheat straw. The pens should either be cleaned out daily or sufficient straw provided to eliminate all dampness.

Before the calf is born, the calving box should be thoroughly cleaned and disinfected to avoid risk of infectious diseases, such as white scour and navel-ill. As a further safeguard, immediately the calf is born the navel string should be tied with a piece of disinfected cord. The severed end of the navel string should then be thoroughly treated with tincture of iodine and sealed with collodion.

Young calves have a highly sensitive digestive system. Therefore, to avoid digestive disturbances resulting from the use of feeding utensils contaminated by stale food or harmful organisms, it is essential to sterilize the feeding pails thoroughly each time after use. All buildings used for calf-rearing should be efficiently ventilated without draughts or a wide variation in temperature.

Stale food should not be allowed to accumulate in feeding troughs or mangers, as this ultimately leads to loss of appetite and unthriftiness. It is most important to provide an adequate supply of pure water ; a calf which is being fed on an ordinary allowance of milk will drink nearly a gallon of water per day.

Exercise and Fresh Air Abundant exercise and plenty of fresh air is as important as good feeding in the rearing of strong, healthy calves, especially if they are intended for dairy herd replacements. Most of the disease problems in dairy herds, particularly tuberculosis, would probably disappear if all calves could be reared on an outdoor rather than an indoor system. This would entail the use of dry, sheltered paddocks or yards, with a section roofed off and well strawed

for feeding and shelter. Under careful management calves should have access to the open air throughout the winter on all but the wettest and coldest days. Under this sytem it would be essential to avoid exposing them to cold winds and excessive draughts through faulty construction of the semi-open air pens.

Summary Milk still remains the No. 1 priority human food; therefore, calves intended for dairy herd replacements and store cattle generally should be reared on a system which enables the rearer to exercise a strict control on the total amount of whole milk used per calf. This system, however, demands more skill than when whole milk can be fed *ad lib.* Under the system outlined in this article the total amount of milk used need not exceed 35 gallons per calf. The provision of sufficient milk, however, is only one aspect of calf-rearing; the other recommendations must receive equal attention if satisfactory results are to be obtained.

With restricted milk feeding, it should be remembered that much of the success will be due to the provision of a suitable dry concentrated meal mixture of calf-nuts after the third week. The mixture should be well balanced with a protein content similar to a pre-war balanced dairy ration. It is essential to provide protein, vitamins and minerals in sufficient quantity to maintain good health and a steady rate of growth. Well-reared calves are evenly proportioned and will have a nice silky "bloom".

SEED WHEAT PRODUCTION IN WARWICKSHIRE

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Warwickshire War Agricultural Executive Committee

IN the summer of 1943 it became apparent that the wheat crops in Warwickshire were far from pure, due largely to:

(i) Taking three or in some cases four crops of wheat or other cereal successively on "virgin" soil.

(ii) Failure of many inexperienced growers to exercise due care in the selection of seed corn.

Since the seed required for the wheat acreage in this county is the produce of as much as 8,000 acres, it was decided to improve if possible the standards under which seed wheat is produced. The first step was to ascertain through the seed trade such particulars as were available of farmers who had sown "pedigree" wheat or seed of authentic origin. Contact was then established with those growers and particulars obtained of the cropping history of the field in which the wheat was growing. Fields growing wheat after wheat, unless of the same variety, were excluded.

Threshing Priority follows Inspection Meanwhile, arrangements had been made with the National Institute of Agricultural Botany, through the kindness of Dr. Hunter, for the attendance of a number of the Committee's Technical Assistants at a short course in cereal identification. A list of varieties being grown by farmers and submitted for inspection was then considered by the Seed Production

Sub-committee, and divided into three categories: A, B, and C.* This step was necessary because it was not known how long inspection of the crops would take. When the crops were sufficiently advanced to allow of identification, inspection of the growing crop commenced—A first, B second, and C third.

Inspections were carried out by the Technical Officers working in pairs, each walking two headlands and a diagonal. It was found that as the Inspectors became familiar with their task a 10-acre rectangular field could be inspected in approximately 30 to 45 minutes. In all some 3,707 acres were submitted for inspection, and the three parties of Inspectors completed their task in 18 working days.

Qualification for the issue of threshing priority orders involved:

(i) Purity of stand with "off-types" less than 1 per cent.
(ii) Absence of noxious weeds (wild onion, corn buttercup, cleavers).
(iii) Absence of fungus diseases, particularly Loose Smut.
(iv) Overall evenness of crop.

The standard decided upon in the first year may not have been particularly high, but even at this level only 63 per cent. of the total area was passed for use as seed.

An analysis of the causes of failure reveal the following figures:

	Acreage	*Percentage*
Greater than 1 per cent. "off-types"	535	39
High percentage of other cereals (particularly barley and rye)	240	18
Mechanical mixture due to uncleaned drill ..	210	15
Incorrect variety sown	33	2
Presence of noxious weeds	113	8
High percentage of disease (particularly Loose Smut)	51	4
Poorness of crop	194	14

Precautions to Secure Pure Seed Where crops were found suitable for use as seed, the farmer was asked to sign a statement agreeing to take certain precautions as follows:

1. Before commencing to cut the seed crop the binder must be thoroughly cleaned. If two or more varieties are growing in the same field, cutting must be confined strictly to one variety at a time.

2. Before carting a seed crop all carts and wagons used for the purpose must be swept out carefully, and two or more varieties must never be included in the same stack. Grains from the threshing machine can be thrown a considerable distance by the drum, and may lodge in adjoining stacks. For this reason stacks of one variety of seed corn must be removed as far as possible from stacks of other varieties. They must not be topped with straw or unthreshed grain of another variety.

3. The thresher must be brushed down thoroughly before any seed corn is run through, and the screen, hummeler, and grain elevator examined for lodged grains. It must then be run empty at a good speed for at least 15 minutes, with the slide of the grain elevator open. The first sack of threshed grain must be discarded for seed purposes. All but new sacks must be cleaned by turning them inside out and beating or brushing them. When filled the sacks must be stored in a dry place and out of reach of subsequent contamination.

* Category A includes the varieties which have proved themselves to be the most suitable for milling, and for the soil and weather conditions of this county; Category B less suitable, and Category C least suitable. In justification of this division, it is interesting to note that in all 33 different varieties were submitted.

4. Grain threshed by a combine and artificially dried must be indicated clearly by a label on each sack.

5. Rules applicable to threshing drums apply equally to the cleaning of combine harvesters and drying plants.

On receipt of this signed statement, a threshing priority order was issued.

It may be said that the threshing machine proprietors welcomed the issue of these orders, as it relieved them of the responsibility of deciding between one farmer's needs and another's. The seed trade too generally appreciated the introduction of the scheme as being the first step in a county-wide effort to improve the standard of seed-growing.

Rules for 1944-5 Seed Crop Since the scheme was put into operation only in the early spring of this year, the rules were necessarily confined to the harvesting of the grain. For 1945 the following rules have been incorporated with a view to controlling the crop from start to finish :

1. The preceding crop may only be one of the following :
   - (a) Clover ley.
   - (b) Bare fallow, or fallow crop (roots or potatoes).
   - (c) Wheat of the same variety which has been inspected and certified in 1944.
   - (d) Beans which follow a fallow or fallow crop.

2. Where two or more cereal crops are grown in the same field, they must be divided by a width of at least one chain or a crop other than cereals.

3. Subject to Rule 2, the whole of the field (including the headlands) must be sown with one variety only.

4. The greatest care must be taken to see that the seed drill is thoroughly cleaned before drilling is commenced.

5. Only seed of known origin may be used.

The rules for the growing of cereal seed are those published by the National Institute of Agricultural Botany in *Notes on Growing Cereal Seed Crops*, August, 1943.

SURPLUS STRAW

H. W. Tomlinson

Wiltshire War Agricultural Executive Committee

"STRAW ?—I've so much I don't know what to do with it! " How often do we hear that remark to-day ! With old, well-farmed arable and recently ploughed-out permanent grassland both contributing to bread corn, straw has become an embarrassment in many areas. But that is no reason for burning it, as happens all too frequently. Corn-growers of the last century considered it very bad practice to sell either hay or straw off the farm. The hay was fed to home stock which in turn turned the straw into good muck to maintain soil fertility. The use of straw in this way is as important to-day as it was then—perhaps more so. Ley farming, for example, requires plenty of organic manure, especially in the establishment of good seeds leys.

Spreading behind the Combine Little difficulty is experienced in dealing with straw behind the combine when the following crop is to be spring sown and the land does not require autumn cultivation. The peg-drum type of combine will break the straw of a ripe cereal crop, and a straw-spreader fitted to the machine will do away with rows. A grass-mower or reaper will shorten the long stubble with little trouble, the freshly threshed straw lying lightly on top.

A mixture of Italian ryegrass and trefoil, undersown in the corn crop, will usually make a fair growth during the autumn. This will grow through rolled straw and stubble and keep it moist enough to rot. A dressing of nitrogenous fertilizer and treading by live stock will accelerate the rotting. Thus we get something like a dressing of dung or compost to plough in during the winter.

On poor clay land at Sandridge, wheat straw from a ten-sack combined crop was ploughed in for a second wheat crop. A fair job was made with a 12-inch furrow when sharp disc coulters were set deep enough to cut the straw. The second wheat crop compared favourably with others where the binder was used and the crop stacked.

On very light, black soil overlying chalk on North Down, ploughing for the second barley crop after virgin downland was considered undesirable. The straw from the first crop, combined without a straw-spreader, was scattered with five tines in a nine-tined cultivator. The cultivator, set just deep enough to prevent the straw collecting on the points, was operated by a Fordson tractor running in second gear across the rows of straw. Repeated heavy disc harrowing during the autumn and spring, in preparation of the seedbed, completely broke up the straw and stubble. The second barley crop yielded 13 sacks per acre, and the grain was of good quality.

Folded sheep on the stubble left by the combine will trample the straw and assist in its decay, particularly when the corn crop has been undersown with Italian ryegrass and trefoil, and perhaps supplemented by roots hauled on.

A full crop of sound straw is difficult to plough in, especially when the furrow is narrow and shallow. Rolling, followed by heavy disc harrowing, will mix the soil and straw and so hasten decay. In all cases the sooner the straw and stubble are bruised and rolled or trodden down, the quicker will they decay. As the weather gets colder the process of decay slows down.

Straw from Stacks Straw well broken up during threshing facilitates subsequent decay, and in this connexion the peg-drum thresher is helpful, although it is not so good as a chaff cutter or straw bruiser. Straw carried over from the previous harvest is more brittle than that from a new crop.

If the straw can be applied direct to the land less handling and haulage are required. But it must be chaffed unless it can be applied to those fields where further cultivations will not be required until it has had time to rot.

On fields where the stubble is left unploughed until late spring, a heavy dressing of long straw can well be applied to the stubble during the autumn. A similar weight of partly decayed broken straw can be applied during the winter. Chaff can be put on at a still later date.

If a spring cereal or potato crop is to follow a one-year ley, a moderate dressing of straw (½–1 ton per acre) can be spread during autumn, when the ley is short of grass, and then rolled down. The grass will soon grow through and pull the straw in.

Leys can also be strawed after hay harvest. Later, leys of more than, one year's duration can be strawed if the dressing is kept down to a coat that will not kill out the grasses. Early winter application is desirable for obvious reasons. Broken weather is ideal for strawing leys ; it prevents the straw from blowing about.

The ploughing in of the maximum amount of straw that can be buried with a single-furrow, deep-digger tractor plough as a preparation for potatoes has proved satisfactory. The job should be carried out early in the winter.

Trampling with Sheep The practice of littering the sheepfold has much to commend it in wet weather. The flock thrives better. Long, sound straw spread in the spring obstructs ploughing, but short or broken straw presents few difficulties.

Strawing the growing crop of roots or kale in front of the sheep is preferable to strawing the back fold. Formerly it was common to straw cereals and vetches during the winter and so obtain an earlier feed for sheep folding.

Dung and Compost The greatest possible use should be made of straw to soak up the precious urine from all live stock in sheds and yards. A good deal of straw can be trodden during the winter months in temporary yards walled with straw bales.

Straw compost will generally be out of the question unless the stack sites have water laid on to them. Where water is available, composting can be arranged by the usual process as threshing proceeds. Where there is no convenient water supply, the heaps should be flat and wide, so that they become partly broken down as rain soaks into them. Straw heaped in this way, with or without sulphate of ammonia or carbonate of lime takes less time to decay when hauled out on to the land some months later.

APPROVAL OF PROPRIETARY PRODUCTS FOR THE CONTROL OF PLANT PESTS AND DISEASES

WETTERS AND SPREADERS

The Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland have already invited applications for the official approval of proprietary lead arsenate powders, lead arsenate pastes, lime sulphur washes, miscible tar oil winter washes, stock emulsion tar oil winter washes, organo-mercury dry seed dressings, copper sulphates, copper fungicides (exclusive of seed dressings) and derris and lonchocarpus insecticides. Lists of approved products in these groups are published from time to time in this JOURNAL.

In addition to further applications in the above groups, the Ministry and the Department are now prepared to receive applications for the official approval of wetters and spreaders. Applicants must be either the manufacturer or the authorized agent under whose name the product is sold. For a product sold and used in Great Britain but manufactured elsewhere, application will be accepted from the authorized selling agent resident in Great Britain.

Requests for application forms, indicating the number of applications to be submitted in each of the above groups, and for particulars of the scheme if required, should be sent to the Secretary of the Advisory Committee, Plant Pathology Laboratory, Milton Road, Harpenden, Herts. A separate form will be required in respect of each proprietary name.

GREEN PASTURES

II. CULTIVATIONS FOR GRASS*

W. A. Stewart with Stanley Kippax of Warton Lodge, Lytham, Lancashire, and N. V. Hewison, late of the South-Eastern Agricultural College, Wye, Kent . . . . (B.B.C. Home Service, October 19, 1944)

MR. STEWART opened the discussion by inviting the views of his two practical colleagues on the best ways and means of making sure of a good "take". There have been many failures: how can they be prevented? Mr. Hewison suggested that there were two problems: the reseeding of poor, old turf, and the seeding of exhausted arable which after four or five straw crops was full of weeds. Mr. Kippax said that first of all the economy of the farm must be considered. A night pasture on a dairy farm must be conveniently near the cowshed and provided with water; if ploughed up and reseeded it might soon become a quagmire. On more distant old pasture due for reseeding he would begin by discing and churning up the old mat adding, perhaps, some sulphate of ammonia to promote decay. Then he would plough flat and deep enough to secure three or four inches of good, workable soil on top. Before sowing he would disc again, sample for analysis, and finally apply lime and fertilizers as required.

Getting the Land Clean Regarding the cleaning and seeding of worn-out arable, Mr. Hewison, who farms in Kent, depends chiefly on autumn cultivations followed by deep ploughing for cleaning purposes, and on subsequent winter weathering to obtain a kindly spring tilth. For the North, where harvest is later and the rainfall greater, he thought the only course is a summer fallow. To his mind the plough is the only tool for a summer fallow and the only means of killing thistles.

Mr. Stewart agreed that there is nothing like a bare fallow for cleaning foul land, particularly heavy land, but it makes no immediate contribution to the food supply; so why not potatoes or a root crop? Both Mr. Hewison and Mr. Kippax objected that in these days of labour shortage the land may be weedier at the end than at the beginning of a rootbreak. In Lancashire the War Agricultural Executive Committee is inclined to compromise, sacrificing May, June and July for fallowing and sowing the seeds early in August. Mr. Hewison did not think it is as necessary to fallow land in those districts where it can be cleaned in autumn—except possibly on very heavy soils.

At this point, Mr. Kippax interpolated a question about the cultivation of ridge-and-furrow land. Mechanization, he said, is tending to destroy this ancient configuration and to leave the land wet and liable to poaching. Mr. Hewison, on the other hand, would get rid of ridge and furrow; it obstructs haymaking and harvest. Mr. Stewart warned against dogmatism. Speaking of the Midlands, he would retain the ridges where drainage is difficult, but abolish them where they had never really been justified.

Seeding with or without a Nurse Crop Reverting to the subject of seeding, Mr. Stewart asked: is it to be with or without a cereal? Mr. Kippax would use a nurse crop only where he was certain to avoid lodging; in peace time he would

* A summary of the first discussion in this series was given last month (pp. 343–6).

never use a nurse. Mr. Hewison, however, objected strongly to seeding without a cereal. For one thing it does not do away with thistles and buttercups. In reply to a suggestion that Italian ryegrass might act as a nurse, he said that in Kent it did not die off but persisted in the mixture. (*Mr. Hewison likes to harvest wild white clover seed from his new leys—Editor.*) Rape, he said, was apt to smother the grasses since sheep always preferred the latter. He liked to broadcast early in March under a full seeding of an autumn cereal and so get corn and seeds as well. He agreed with Mr. Stewart that in some circumstances—for example, a dry soil in a dry climate—a case could be made for drilling, provided a drill were available with row spacing no greater than three or four inches. It was generally agreed that in the North, where normally there is no difficulty about establishing a plant, broadcasting is to be preferred; and it is neither necessary nor desirable to sow as early as farther south.

There was general agreement on the importance of rolling. Mr. Kippax rolls both immediately after sowing and when the seed has germinated, and Mr. Hewison rolls after harvest before submitting the "seeds" to a light grazing by sheep.

Pioneer Crop on Marginal Land The discussion then turned to marginal land. Is a pioneer crop desirable? "Definitely," replied Mr. Kippax. "On our marginal land . . . a pioneer crop is essential." This would generally consist of a mixture of 1½ lb. rape, 1½ lb. white turnips and 15 to 20 lb. of Italian ryegrass, per acre.

Hewison: You're talking about impoverished land—land that is run out?

Kippax: Yes.

Hewison: Well, is this land going to grow anything worth the labour you've put into it? Is it worth while? Why not just plough it and fertilize it properly?

To this Mr. Kippax replied that it was necessary to plough and fertilize for the pioneer crop, and that the manurial reserve from folded stock was more lasting than from artificials alone. Further, decomposition was quicker and consolidation greater. Mr. Hewison, however, was not convinced that a crop worth folding could be grown. "If you only grow a crop an inch or two high," he said, "the sheep will just walk over it—they're not there long enough to fertilize it." Mr. Stewart was disposed to agree with Mr. Kippax, and then directed the discussion to alternative pioneer crops, e.g., potatoes. This suggestion, however, was unreservedly condemned by the Lancastrian; such a crop would only use up fertility. Mr. Hewison, on the other hand, thought that where there was reasonable depth of soil an excellent tilth was obtainable after early or mid-season potatoes, but if there must be a pioneer crop why not the best of all—Italian ryegrass and red clover, grazed and not cut? (*But on marginal land would such crops be any more easily or successfully grown than rape, turnips and Italian ryegrass?—Editor.*)

Mr. Hewison was equally emphatic in his preference for ploughing instead of repeated discings as a preparation for reseeding, and Mr. Kippax agreed that old turf was better ploughed.

The Broad Lines Summing up, Mr. Stewart said that actual methods and times of carrying out the different operations varied a lot between the hotter, drier South and the cooler, wetter North; each area has its own local problems. If the broad lines indicated in the

discussion were followed, ley failures should be few. Clean land, having recourse possibly to a bare fallow on heavy soil, a properly prepared seedbed, early sowing, and the requisite manuring, should go a long way to ensure the end in view.

III. GRASSLAND MANAGEMENT

W. A. Stewart with Captain R. H. Hall of St. Breward, Bodmin, Cornwall, and Martin Jones of the North of Scotland College of Agriculture, Aberdeen. (B.B.C. Home Service, Nov. 2, 1944)

ASSUMING that the ley has been properly seeded, the next thing to consider, remarked Mr. Stewart, is how best to establish it. Considering first a ley seeded without a nurse crop, Mr. Jones said that in the Scottish highlands the aim is green keep for the ewe hoggs on the hill in winter. The ley, therefore, has to be well established by June, when it is grazed by cattle until August and then rested for the sheep—cattle first, because they tip the plant and cause it to develop a bushy bottom. Captain Hall favours grazing with cattle and sheep simultaneously. Having allowed sufficient time for strong root growth, heavy stocking is then necessary to effect consolidation. After a rest he again stocks heavily until late autumn, then dresses it with some well-rotted farmyard manure to give an early start in February or March. Mr. Jones's objective being winter keep, he likes to rest the pasture once the seed-producing time is past—mid-August—so as to get only leafy herbage later. He added that sheep do not scour badly on grass eight weeks old. Thus it was shown that management must and can be adjusted to suit the needs of the class of stock kept.

At this point some reference was made to weeds, thistles particularly, and to the desirability of trimming with the mower. The discussion then turned to rotational leys sown under a cereal in spring. How should they be treated?

In Mr. Jones's view it is very bad to allow new leys to become winter proud. Sheep should be turned on at least once—about a month after corn harvest. This was generally agreed, Mr. Stewart remarking that he had turned on cattle also. "As a matter of fact," said Mr. Jones, "cattle deal better with a stubble ley than sheep, so long as they don't poach it. . . . Under a cereal, grass has practically no side shoots; it is attenuated and drawn out." Nevertheless, Mr. Stewart thought that the shade provided by the cover crop prevents the seeds from being frizzled up in drought. This, apparently, does not occur in Cornwall. Only under war conditions and on good corn land would Captain Hall tolerate a nurse crop.

Hay or Grazing the First Year? Next came the vexed question of hay or grazing in the first year. Mr. Stewart would graze the first year, cut the second, and graze the last. Mr. Jones, referring to Aberdeenshire, would take hay in the last year to safeguard the ensuing oat crop from lodging. Grazing in the first year is preferable to haying. Captain Hall disagreed with both speakers. He depends on his leys for his hay ricks; therefore he mows early (about the end of May) and gets a quick-growing aftermath, which is grazed by cattle and sheep

for the rest of the year. A portion of the summer hay is "foddered back" to keep up fertility. Captain Hall thought that even if clover is mown for an early hay crop, as much nitrogen is obtained from the clover roots as would be by grazing.

This led Mr. Jones to adduce some figures which astonished the other two speakers. He could not say how much nitrogen is fixed by clovers, but he claimed that in a whole grazing season the animal returns to the land the equivalent of 8 cwt. of nitrogenous manure, 4 cwt. of potash manure and 4 cwt. of phosphate manure, per acre.* To get such a return Captain Hall thought an enormous crop of stuff would be necessary. "Twelve tons of fresh grass," replied Mr. Jones.

Influence of Stocking on the Sward The next problem was how and when to decide that a pasture has passed its best and should be ploughed up. Mr. Jones said that when half the plants are only volunteers the sward is beyond its best and should be ploughed out. Captain Hall, however, had a good word to say for some volunteers, among which he included wild white clover, rib-grass and yarrow. He asked Mr. Jones when he considered the average long ley to be past its best. "Three years," replied Mr. Jones, "but there is no need for them to reach it for at least ten." Mr. Stewart then reminded Mr. Jones of his plots at Jealott's Hill, where, by varying the management, he got whatever kind of sward he liked from the same seeds mixture. "It was all done by the animals" Mr. Jones explained. Actually four different swards were turned out from the same seeding—a clover, a rye-grass, a cocksfoot, and another where weeds took possession. Spring stocking increased clover at the expense of the grasses. Grassy swards were produced by allowing the grasses to grow away and overshadow the clover. Ryegrass benefits most by protection in early spring (March and early April), and cocksfoot during the latter part of spring (late April and May). The weedy plot, full of thistles, bent and Yorkshire Fog, was got by grazing all the year round without much change in the rate of stocking.

Plants, which are late, such as bent (agrostis) get through their initial stage unmolested, and being relatively unpalatable are neglected by stock when there is more keep about. Thus they tend to become strong and crowd out the other plants. He added that this applies to old as well as to young pasture.

The conclusion of the whole matter, said Mr. Stewart, is control of grazing, and to control grazing properly it is necessary to know your grasses.

Captain Hall likes to have some old grass about the farm. Buildings may not be sufficient to house all the stock, and old grass is necessary for outwintering. On stock-raising farms one must be able to carry enough stock through the winter to graze the new leys in summer. The more you tread and fodder a sound pasture in winter, he contended, the more you improve the natural vegetation, provided you thoroughly harrow it in spring. It was generally agreed that surface cultivation without manure is of little benefit to pasture.

It is understood that these figures were computed on the basis of nitrogen as sulphate of ammonia, potash as 30 per cent. potash salts, and phosphate as superphosphate (18 per cent. P_2O_5); but in our view the figure for phosphate, in terms of standard superphosphate, would be nearer 2 cwt.—*Editor.*

Value of Nitrogen Grassland needs lime and phosphate, and sometimes potash, said Mr. Stewart, but what about nitrogen ? "A grand thing," replied Captain Hall, ". . . preferably Nitro-chalk." On his land it improves the clover after grazing and after an early cut of hay. Mr. Jones pointed out that nitrogen applied to hay undoubtedly tends to discouragement of the clovers and loss of phosphate and potash from the soil. Given to pasture, however, practically all the manurial ingredients are returned to the soil and fertility is built up. As regards nitrogen, a manure that will become available gradually and slowly is to be preferred.

These remarks were well received by Captain Hall, who likes to put farmyard manure on his new pastures in the autumn. He thinks that many of the modern school depend too much on artificials and forget that "the muck cart is the father and mother of England". "Always provided you let the animal cart its own muck," added Mr. Jones.

In Short Mr. Stewart summed up to the effect that in establishing a pasture early grazing, preferably with cattle, and with sheep so long as they do not eat the heart out of it, is essential. The three-year ley is a sound means of providing fodder and building up fertility, and the best practice is to graze, not cut for hay, in the first season. There is also a case for building up fertility by foddering hay and other food to stock during winter. Finally, to manage grassland properly it is necessary to understand the habits and life-story of the principal grassland plants and weeds—the fundamental botany underlying the job of ley farming.

IV. GRASS BREEDING AND SEED PRODUCTION

W. A. Stewart with Professor T. J. Jenkin, D.Sc., of the Welsh Plant Breeding Station, Aberystwyth, and J. A. Lindsay, Agricultural Organizer for Shropshire. (B.B.C. Home Service, November 16, 1944)

INSTEAD of requiring twenty years, as formerly, a pasture can now be made in a few weeks, said Mr. Stewart. Is this largely due to the modern use of indigenous grasses and clovers ? Dr. Jenkin replied that before the introduction of indigenous types the only grass seed available in commerce was obtained from plants prone to seed production at the expense of persistency. They were different from the grasses found in old pastures—types which for generations had stood up to continuous grazing right on into the autumn. The "bred" grasses are based on those which survived this treatment. It is true, however, that some practical men had tried, long ago, to introduce indigenous types by inoculation, transferring turves from old pastures for insertion here and there in new pastures.

The "Indigenous" Grasses Mr. Lindsay objected to the use of the term "indigenous" in connexion with the new technique ; the new grasses do not necessarily originate in this country. Indeed, as Dr. Jenkin explained, S.23 ryegrass was based partly on material brought from Holland. "Amsterdam and Aberystwyth," he added, "are almost exactly on the same latitude. I once had an idea that I would introduce hardiness by getting material from Norway and Sweden, but Northern European grasses never started growing in Aberystwyth until well on in May. Then they rushed into production and went

off early in autumn. They certainly were not hardy. They weren't adapted to the different length of day." The first example of an indigenous pasture strain was wild white clover, and here, again, there is an affinity with Holland. "Whild white," he said, "is to Dutch white what leafy perennial ryegrass is to ordinary commercial ryegrass. They are the product, not of conscious selection by man, but of unconscoius selection through the consistent form of management practised over a long period."

At this point Mr. Lindsay interpolated that neither wild white clover nor any other persistent strains could have been established successfully without phosphates. The others agreed, but were not to be deflected from the genetic aspect. There was cocksfoot and timothy. Dr. Jenkin remarked that before the introduction of leafy strains the seed used was obtained, as with ryegrass, from hay types, with the difference that cocksfoot and timothy have not been in cultivation for so long as ryegrass ; consequently seed propensity is somewhat less pronounced.

Mr. Stewart then asked how pedigree leafy strains are established and maintained. In reply, Dr. Jenkin took S.23 as a good example. The original plants were selected on type from old pastures in Leicestershire, Northamptonshire and Kent, with smaller amounts from Pembrokeshire, Lincolnshire and Holland, and traces even from Belgium and Norway. They were intercrossed, and after interbreeding those that were satisfactory were perpetuated vegetatively. Thereupon Mr. Lindsay suggested that the farmer would be asking whether selection and breeding, which make pedigree seeds so expensive, is justified by performance on the farm. In support of breeding, Dr. Jenkin quoted figures from an experiment in Pembrokeshire laid down in 1935, where "all commercial" strains were compared with "all Aberystwyth" strains, wild white clover being common to both lots. After eight years there was 6 per cent. of ryegrass in the commercial plots and 30 per cent. in the Aberystwyth plots.

"But what about palatability ? " asked Mr. Stewart. Is it true that cattle prefer the commercial types ?

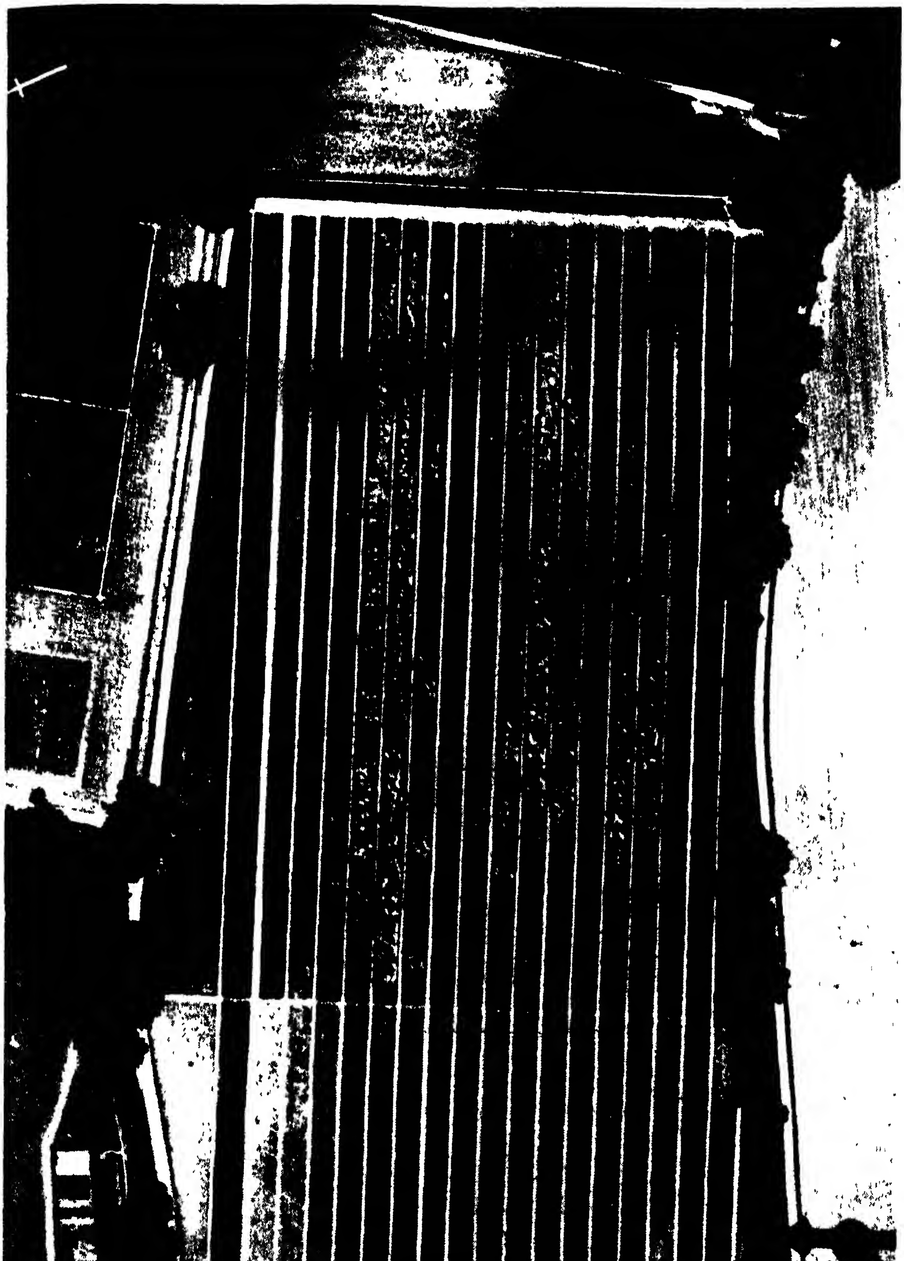
Mr. Lindsay thought not. Dr. Jenkin said that it depended a good deal on the stage of growth at which the animals are put on. Commercial strains are generally early and first growth is relished, but S.24 is actually earlier than commercial and bulkier with less stem. This also applies to leafy strains of cocksfoot and timothy.

Leafy Strains for Grazing and Hay Mr. Stewart inquired whether by including leafy strains it would not be possible to get a good three-year ley suited to grazing for two years and hay for one year. Dr. Jenkin answered that Aberystwyth hay strains, e.g., S.24 ryegrass, S.37 cocksfoot and S.51 timothy, blended with pasture and other strains, fulfil all requirements very well. The inclusion of commercial strains reduces the cost.

For two-year leys, Mr. Lindsay recommended one-third leafy and two-thirds commercial strains, and for longer grazing or dual-purpose leys, one-third commercial, one-third leafy hay and one-third leafy pasture types. Mr. Stewart thought more leafy types might be included in two-year leys, especially as dairy farmers are inclined to cut hay early for the sake of getting a better aftermath, and Dr. Jenkin suggested equal proportions along with S.100 white clover.

Mr. Lindsay agreed, and for short-term grazing leys he thought Italian ryegrass should be more widely grown. For thin, limestone soils, he would add lucerne or sainfoin in preference to S.100, and so get more hay.

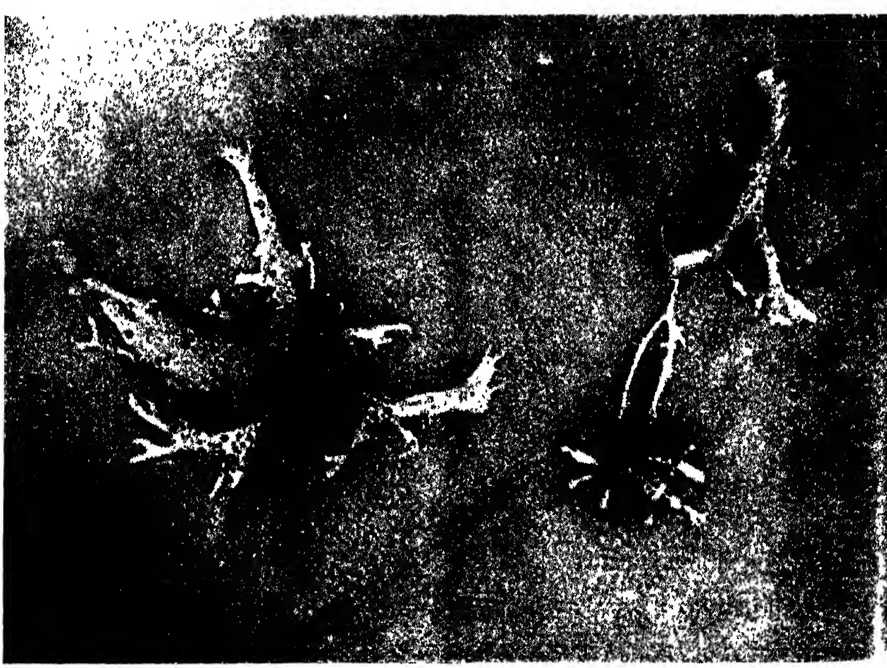
PHOTOGRAPHY IN AGRICULTURAL RESEARCH (See pp. 414-7)



(Photo Rothamsted Experimental Station

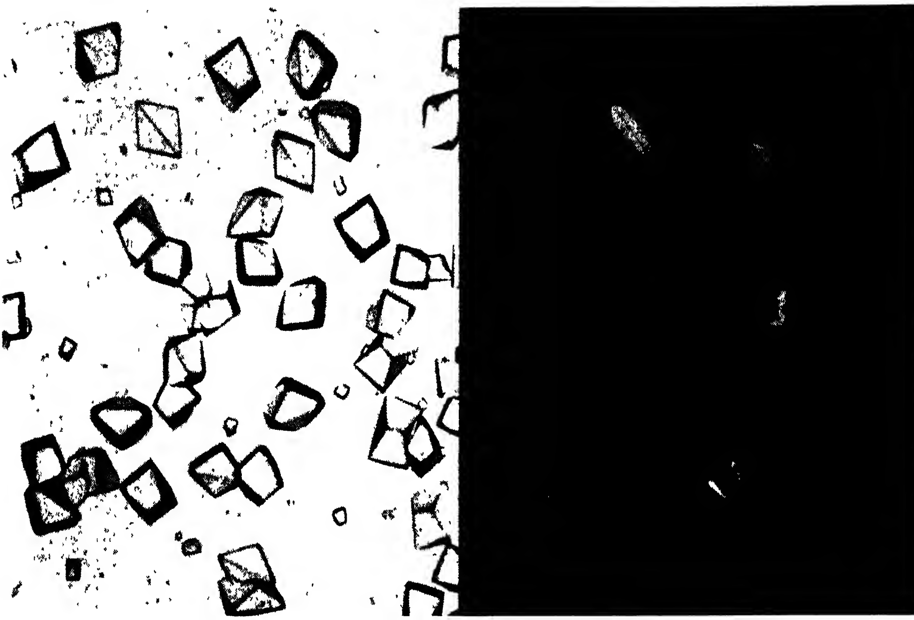
Aerial view of Broadbalk wheatfield from 3,000 ft., taken in July, 1930 The differently manured strips are clearly visible The lower, light-coloured part was under crop the previous year, the rest was fallow. Lodging shows up as the light, irregular patches

Effect of increasing amounts of potash on buckwheat Record of that part of an experiment in which all pots have the same amount of nitrogen and phosphate, but the amount of potash increases, from *left* to *right* being 0, 15, 30, 45, and 90 mg. of muriate



(Photos *Rothamsted Experimental Station*

Giant amoeba found in soil. The individual on the right has almost finished dividing into two daughter cells (Magnification × 50).

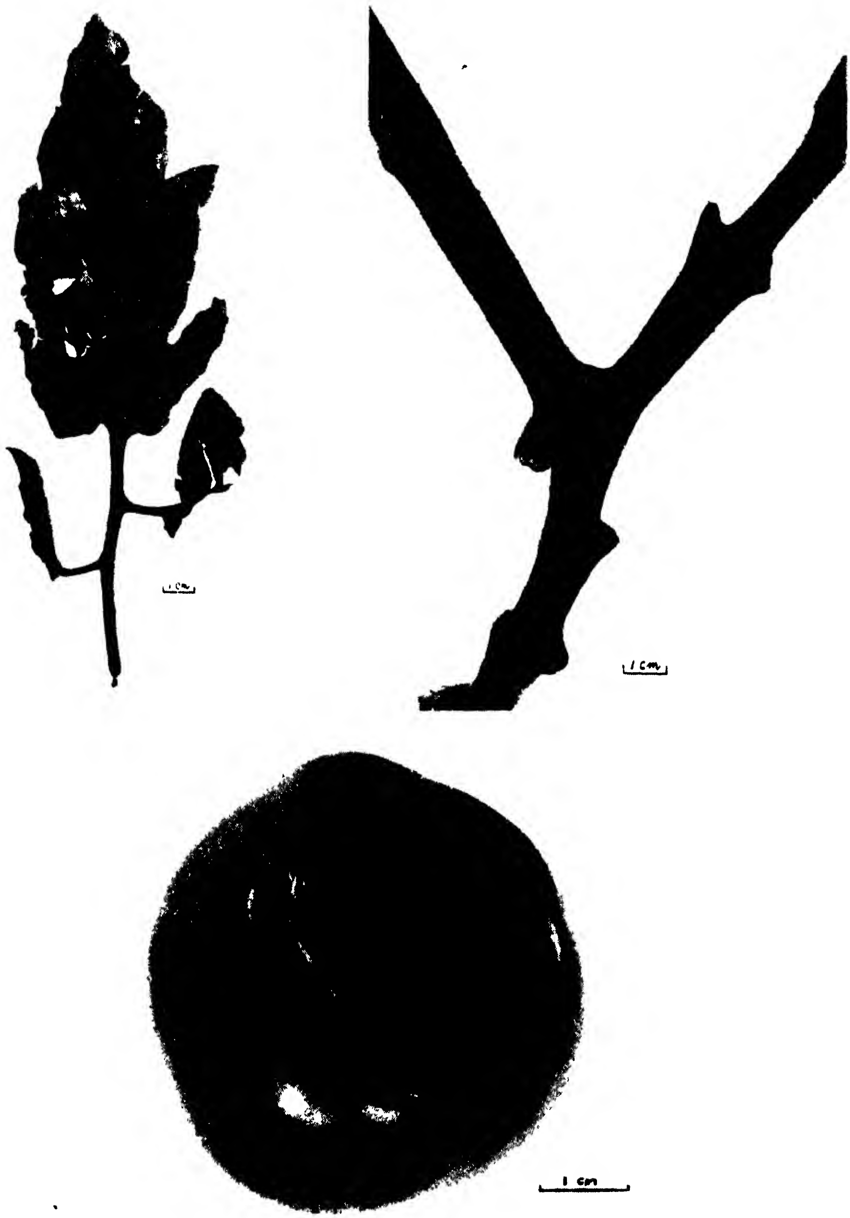


Crystals of a Tobacco Necrosis virus. Each crystal contains millions of virus particles. *Left*: in ordinary light. *Right*: in polarized light. (Magnification × 100).

(Photos: *Rothamsted Experimental Station*

Particles of the clay mineral Halloysite, photographed in the electron microscope (Magnification × 70,000).

ALTERNARIA BLIGHT OF TOMATOES (See pp. 417-20)



(Photos *H. H. Glasscock*

Top *Left* LEAF— Angular spots with concentric ridges.

Right: STEM—Dark brown sunken spots with light grey raised centres

Bottom. FRUIT —Brown and shrunken at calyx end, with black, velvet like growth of fruiting fungus.

Attention was then turned to dry districts with high summer temperature. Would leafy strains tend to prevent drying out ?

Dr. Jenkin's view was that the ground must be covered quickly and, therefore, a heavy seeding is necessary, particularly of ryegrasses, since cocksfoot does not cover the ground so evenly and densely as leafy ryegrass. Mr. Lindsay agreed about the need for density, but thought that cocksfoot, if it could be sown thickly enough (say, 15 lb. per acre), would resist drought better.

As regards the number of species in a mixture, Dr. Jenkin thought that four species, with more than one strain of each, would serve most purposes satisfactorily—ryegrass, cocksfoot, timothy and clover. All agreed.

Seed Production Next, how far is it considered that seed-growing can be combined with ordinary ley farming ?

Mr. Lindsay's opinion was that ryegrass and wild white clover seed production fit in well with mixed farming, because in either case the ley can be used for seed in the first and second years, and subsequently grazed. Dr. Jenkin agreed but warned against seeding a bred line of white clover after the third year, because of the danger from volunteer seedlings. (*No reference to taking wild white clover seed from old pastures was made.—Editor.* To avoid cross-fertilization or volunteers the seed grower must make up his mind to grow, even in ordinary leys, only the particular strains of grass or clover from which he is going to take seed. As to isolation, it was thought that 200 yards would be safe with clovers. Seed-growing is suitable for the small man as well as the large farmer ; the former can give greater personal attention.

Should a seed crop be drilled or broadcast ? Dr. Jenkin favoured wide drills on good land for leafy strains. The cost of inter-drill cultivation is repaid by a yield usually twice as great. Mr. Lindsay was doubtful. With drills there is no cash return at all in the first year, whereas if cocksfoot is sown with red clover under a nurse crop, there is a return from corn in the first year, from red clover in the second, and from cocksfoot in the third. This raised the question of the effect on fertility of taking three seed crops in succession. Even with seed, however, as indeed with hay, there are generally returns to the land in the form of muck. With that and fertilizers, soil exhaustion need never be feared.

Mr. Stewart then inquired as to the possibility of growing grass seeds competitively in this country after the war. So far as soil and climate are concerned, Dr. Jenkin considered that Britain can hold her own with any country, but there must be high fertility. Imported seed may be more attractive to look at but appearances in this matter are deceptive, and there are dangers in growing on from imports of, say, red clover.

As regards harvesting ryegrass, Mr. Lindsay favoured cutting by mowers leaving for a week to dry and then sweeping up to the thresher in the field. The ordinary binder adjusted to turn out small sheaves, which Dr. Jenkin prefers, is often unworkable with a heavy crop, he contended. Combines can be used for large areas, preferably by picking up from the swath. It was generally agreed, however, that for cocksfoot and timothy grown in drills, the ordinary binder is the most suitable machine ; also, that on small farms the combine might be used as a stationary thresher. For harvesting clover, Mr. Lindsay had a good word to say for tripods.

Finally, Mr. Stewart insisted that never again must pasture be allowed to tumble down. We now had the seeds and the mixtures and the technique to make a proper job of sowing out.

SCIENCE AND THE FARMER

, DUNCAN McGUFFIE

Alcester, Warwicks

DURING the last few years I have seen many farms that would have benefited by a visit from a scientist, and many research stations that would have benefited by a visit from a farmer. As a farmer I know that a visit by anyone to the farm during rush periods is unpopular, and I have no doubt it is the same in the laboratory. Nevertheless, it is only by the very closest co-operation between farmer and scientist that agriculture will progress.

Many efforts have been made recently to bridge the gap between farmer and scientist, and it is worth while studying these efforts to see how improvements may be made in the future.

Getting Together First, I think it is up to the farmer to spare no effort to ensure that the scientist enjoys his visit to the farm, and in peace time, anyway, to provide refreshment. It is very often during the smoke after a meal that difficulties are confided. The scientist does not think it worth while, perhaps, to describe to the farmer the life history of the particular insect that may be giving trouble; and the farmer, in his turn, may think it irrelevant to speak about precultivations, liming, manuring, or the previous cropping. Yet it is only by the sum total of all this information that the practical solution to the problem can eventually be discovered. In the experimental stage the scientist often wants the farmer to carry out a strip trial, which means more work for the farmer, perhaps when it is most inconvenient; and again, the farmer often has some theory of his own which he would like the scientist to work on in his laboratory. Unless, however, the feeling of goodwill between the two runs strongly, these jobs simply do not get done.

Take for example a case of wireworm infestation a year or so ago. Many farmers, myself included, thought it a waste of time to go round taking counts of wireworm per acre. I had seen crop failures where the count had been comparatively low, and under the same conditions successes where the count had been high. I believed that thorough cultivations was the answer to the problem. These two conflicting opinions came to a head at the Grassland Improvement Station, Dodwell, where farmer and scientist are on the best of terms. Here a count on a field, before and after a variety of cultural treatments by the farm director, showed that a thorough working of the top five inches of old turf and turf roots during the late summer months reduced the wireworm count by over half. This information has proved most useful to farmers breaking turf for the first time.

Between scientist and farmer reciprocal contact on their own ground is essential. One particular research station was asked to carry out work on row-crop machinery. They conducted the most interesting and important trials as to the best position for the row-crop frame; whether it should be in front of the tractor, beneath it, or behind it. They then discovered that the tractors providing the motive power for this work were considerably underloaded and worked hard to discover how this fault could be remedied. Now the average farmer is not concerned about this underloading, for the whole row-crop operation costs, at the most, 3s.–4s. an acre, but what does concern him is how much hand work he can save at 30s.–40s. an acre. Thus it is the *accuracy* of the machine down the plant rows that is his chief concern, and it is on this point that he requires further research.

Nearly all agricultural and horticultural machinery requires a considerable reserve of power. An extra furrow on a plough is all right until you come to a stretch of clay or a bank, then the tractor driver either skimps the work by shallowing the plough or ruins the machinery by trying to "snatch" it through. Fruit-growers know only too well that the pumps on their spraying machines must have a reserve capacity of at least 30–40 per cent. With agricultural machinery quality of work must be the first consideration, reliability second, output third, and mechanical efficiency in terms of fuel consumed last.

It is only by personal contact with scientific workers that farmers can get their problems fully understood. Sometimes the boot is on the other foot. Not long ago I happened to go round a scientist's plot pegged out on ordinary agricultural land. The soil was a light loam and had been grossly over-limed. This had produced a trace-element deficiency, which had in turn caused very obvious Heart Rot in the trial rows of sugar beet and turnips. Until then I had always been rather sceptical of the importance attached to trace-element deficiencies and of the practical possibility of overliming. But whether the farmer goes to ask for new research work to be carried out or to learn from existing trials, his visit to the research station is of mutual advantage. If he enjoys his visits half as much as I have during the last few years, he has many happy days in store.

Liaison Work of County Organizer One of the hardest jobs in the farmer-scientist combination falls to the lot of the county organizer and adviser, whose job it is both to collect scientific data upon which experiments can be based and disseminate in terms of practical farming the results obtained. I have seen the work of these agriculturists at close quarters, and it is sufficient to say that they have many trials and few triumphs. In the early stages of the war farmers would go to them and say: "I have been ordered to grow potatoes; how do I do it?" So easy to post them a pamphlet or recite the method to them, but so very much more difficult to look over the field proposed by the farmer, assess its suitability, consider at what time of the year labour is most likely to be available for lifting, and how potatoes can be made to fit into the rotation. The organizer then arranges for the beginner to meet one of the successful potato-growers in the district and to go round his farm. There is always such a wealth of detail that a farmer can absorb when going round another farmer's farm—detail that the organizer has no chance of putting into the spoken or written word.

One of the most important parts of an organizer's job is to pass on information in this way, from one farmer to another. Then again, he has to act as a liaison officer between research station and farmer. Moreover, secondhand advice on the solution of a problem is rarely satisfactory. If the organizer is unable to supply what is required from his own personal experience, it is his job to enlist the services of the appropriate scientist or research worker. The organizer must also work for good co-operation between scientists and between research stations. He is a kind of general practitioner, with a full service of consulting specialists behind him.

Applied Research to Bridge the Gap There are times, however, when even the combined efforts of farmer, organizer and scientist can make no headway, and it is here that the somewhat new branch of applied research comes to the fore. Applied research is something of a halfway island between farmer and scientist, and there

are indications that it may grow rapidly until it touches and closes the gap for all time.

For too long now there have been instances of the scientist having the cure for the farmer's complaint, but not the necessary apparatus to apply the cure on a commercial scale. In this district of Warwickshire our sprouts, savoys, spring cabbage and other winter brassicas have for long suffered from attacks by mealy aphis. For many years the scientists have known that nicotine vapour will kill the aphis, but it was hardly the scientist's job, or the farmer's, to discover a machine that could fumigate plants in the field. So the problem remained unsolved until recently, when the enterprise of a private firm produced the necessary machinery.

Again, at the present time farmers are being asked to sow their old arable fields to grass for grazing and to plough their old turf fields for arable cropping. In many cases the old arable fields have neither water nor fences. Research work is urgently needed to discover the most convenient types of water supply systems for individual farms. The best type of machinery for pipe laying, frost-proof troughs, reservoirs, pumps and pump engines, rams, windmills, and so on, are all subjects on which the farmer wants information. He also wants research work carried out to discover machinery for fencing fields, for if we are to practise ley farming every field will have to be stockproof.

In times to come market gardeners may well adopt irrigation on a large scale. They too will want to know the best types of systems available, and having installed a system they will want to know the best method of using it, the crops most suitable, when to water and for how long, and when aeration and water heating can be practised with advantage. On the subject of the addition of chemical solutions to the water used for top irrigation, there is an enormous amount of applied research waiting to be carried out.

If applied research stations are to be set up, it is necessary that farmers should participate in the responsibility of the direction of the work to be undertaken. In fact, the writer would go so far as to suggest that farmers and market gardeners should be prepared to contribute a proportion of the cost of the research. There is, after all, no one who knows the exact nature of the problems of applied science better than the farmer or market gardener himself. But whatever the set-up the co-operation between the research stations and the farmers must be active and alive, otherwise they will both fail in the work they set out to do.

The Value of Field Demonstrations Once a thoroughly practical solution has been found to the farmer's problem, it is worth while considering how it can best be made widely known. The writer's experience has led him to believe that field demonstrations under ordinary working conditions are by far the most satisfactory means of spreading agricultural knowledge. Illustrated pamphlets, talks supported by films and slides, discussion groups, all serve the excellent purpose of whetting the appetite, but it takes a demonstration or farm walk to give the farmer a final incentive to try something new on his own farm.

Experience in this district has shown that demonstrations are best arranged on broad lines. First of all, necessity must be the guide: if the district has no farming problems there is no need for demonstrations; if there are farming problems then it is best to tackle them one at a time.

Having chosen the subject, it is essential that all concerned—farmer, research worker, Ministry of Agriculture, manufacturer and distributor—should take an active part in the demonstration. But let us see how it works out in practice.

Not so long ago market gardeners in this district indicated that they wanted information on seed drills. A good-hearted farmer-market gardener in the district allowed us to hold the demonstration on his land. We formed a joint demonstration committee composed of the County War Agricultural Executive Committee and the local branch of the Tractor Users' Association. We sent open invitations to manufacturers to demonstrate their seed drills and to attend an informal meeting to be held on the morning of the demonstration to discuss growers' needs and manufacturers' difficulties. Grass seed drills and manure drills were added to the demonstration as subsidiary sections. The Ministry's Horticultural Adviser kindly agreed to open the discussion in the morning and the demonstration in the afternoon. Nearer the day an awkward problem arose. To fulfil the real object of the demonstration actual seed would have to be drilled; but this would mean holding up food production whilst waiting for germination before ploughing in. In the end we overcame the difficulty by putting all the seed into one of the pressure cookers of a local canning factory. The seed came out reasonably dry and quite dead.

The demonstration achieved its object, though it could have been improved upon under peace-time conditions. At the morning meeting manufacturers and research workers were given a useful insight into growers' requirements, and interest in future design of drills was certainly awakened. In the afternoon growers were able to ascertain which type of drill was most suited to their needs and to gain tips on maintenance straight from the manufacturers. We have noticed at nearly all these demonstrations that there is usually some locally made machine which gives a clue to the future trend of design.

I have also been to demonstrations on institute farms, and the idea of an educational farm in each county, acting as a centre for the dissemination of agricultural science, is one that appeals strongly. Demonstrations, whether held on private farms, demonstration farms or on land under the control of research stations, are the best means of spreading agricultural knowledge and generally improving the relations between the different members of the agricultural community.

International Co-operation One more aspect of agricultural science which looms large in the future is international co-operation—the pooling of knowledge. It is not so much a matter of one country being in front of another, as each country having a contribution to make to the common good. If each country will bear in mind that the interests of world agriculture must come before the interests of their own national agriculture, then good progress is likely to be made and stability in prosperity secured.

But whatever plans are made for the progress of applied science on the farm, those plans will not work without the co-operation of all concerned. Co-operation is the life-blood of any scheme; without it, the plan is still-born.

PHOTOGRAPHY IN AGRICULTURAL RESEARCH

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A SKILLED and competent photographic expert is essential in almost all spheres of modern agricultural research. The photographic interests of a large experimental station, such as Rothamsted, cover a very wide range, embracing everything that the layman generally calls "photography," as well as the more elaborate uses of photographic plates and films for spectrographic analysis and X-ray work.

Advantage of Photography over Verbal Description The great importance of the photograph in research work is that it can give a clear, permanent and accurate record of experiments. If we examine two plants, each of which has received different manurial treatments, it is often easy to see the difference between them. But is it so easy to describe them to a friend afterwards, and be sure that he would recognize these differences when he saw them ? Obviously it is not. The research worker is confronted by the same difficulty. He wants to describe to farmers the effects of different manurial treatments, or the appearance of a plant attacked by insects or disease, and he wants to be sure they will be able to recognize the appearance from his description. Or perhaps he wants to record the results of one year's experiments, so that he can compare them with those of the next. In many instances he can, of course, obtain useful records merely by weighing, and this is the most usual method in experiments designed to test the effect on crop yield of manurial treatments and various methods of crop husbandry. But if he has to record the actual appearance of a plant, it may take many pages of writing and then be unsatisfactory.

The matter is further complicated by the absence of clear-cut differences in most experiments. Instead a graduated series is obtained in which all stages between obvious and acute abnormality to the normal are seen. The difficulties of verbal description become so great in these circumstances that any such attempt is practically a waste of time.

The answer to all these problems is the photograph. A good photograph will convey more than pages of print. It has two other advantages : it is permanent, and because the camera lens is "all seeing," will often preserve for future reference effects which were quite unnoticed at the time the photograph was taken. Again, the camera is not greatly influenced by the wishes of the experimenter—it records what is there. An experimental result embodied in a photograph is thus less capable of dispute, since it is open to examination by anyone and tells the same story to all.

Pot Culture Experiments Figure 2* shows an example of this type of recording. It shows part of an extensive manurial experiment on buckwheat carried out in the pot culture houses of the Chemistry Department. The environment here is the same for all the plants, so that with a uniform plant stock one can be fairly sure of obtaining a uniform response to manurial treatment. This photograph shows the effect of keeping the nitrogen and phosphate constant, and of feeding different quantities of potash. The pot on the extreme left, which contains no added potash, carries a stunted, diseased plant. As potash was increased, the plants became healthier and more vigorous. It can be seen that the major part of the extra growth is in stems, and that the total amount of leaf area is not greatly increased by potash alone, although flowering is. It can also be seen that lack of potash has upset the water

* See art inset.

relations of the plant, and that those deficient are drooping and withered in appearance and the edges of the leaves are curled. The leaf markings characteristic of potash deficiency can be discerned on the plant on the extreme left. All this and more can be recorded by such a photograph and kept for future reference. A large proportion of the pot experiments at Rothamsted are photographed in this manner, and special light-reflecting screens are installed in the pot culture houses.

Similar records are made of diseased plants, and these are extremely valuable for passing on information and for diagnosing such diseases. Many diseases are characterized by alterations in the shape and appearance of the plant, and these are best shown by a picture. Others, especially those due to mineral deficiencies and viruses, have particular markings on the leaves, stems, fruit, etc. In this field, colour photography is very valuable, because many of the lesions and deficiency markings have characteristic colours which do not show up so distinctly in black and white. Unfortunately it is impossible to reproduce an example here. Besides colour photography, other special techniques are often of value. Thus, the small black spots of the "streak" diseases of potato do not show up well when photographed in the ordinary way, and they are difficult to see even with colour photographs. If, however, the pictures are taken in infra-red, the lesions are recorded excellently.

Crop Photography in the Field So far we have been dealing with the photography of single plants or small groups under easily controlled conditions. When we come to crops in the field, difficulties are much greater. As a rule, field crops are disappointing subjects to photograph, because the plots are usually fairly large, and the mass of plants tends to obscure the variation in appearance of any one of them. It is only when the differences are very striking that the result is of real value. For this reason, field plots are seldom photographed at Rothamsted, in spite of the usefulness of the records if they could be obtained.

However, in 1925, a new departure in crop photography was made by the taking of the first aerial photographs by the R.A.F. at the request of Rothamsted. These were an unqualified success in showing up differences which were quite invisible from the ground. For instance, it became possible to see clearly the effect of tree shadow on a crop of mangolds. Figure 1 is an aerial photograph of the famous Broadbalk wheat field, taken in July, 1930, from a height of 3,000 ft. Although the plots can be differentiated by eye at ground level, they make very disappointing photographs from the ground. Here, however, the differences are obvious. The dark strip along the top has always received farmyard manure ; the next, no fertilizer at all. The rest has received various combinations of nitrogen, phosphate, potash, soda and magnesium. It will be noticed that the lefthand edge of the picture is lighter than the right. This section of the field was under crop the previous season, whereas the rest was fallowed. The amount and distribution of lodging can be clearly seen, and its relative distribution among the areas previously under crop and under fallow. This gives a very good idea of the type of thing which an aerial photograph shows up.

Photography with the Microscope Let us pass now from considering acres compressed into a single picture to the other end of the scale—photomicrographs. The necessity for obtaining clear, precise records is not confined to the most common material

Rothamsted is interested not only in the plant and the soil, but also in those things which live in the soil and which perhaps attack plant life. A great number of these are microscopic ; indeed, the viruses, for example, are too small to be visible, even with the best light microscope.

The early microscopists were particularly conscious of the need for a pictorial record of the wonders which they saw, but it was not until photography was available that much of the tedium was removed from the production of such a record. Now we have special cameras which attach directly to the microscope, or an adaptor can be used with the ubiquitous Leica. (The Leica is used almost exclusively at Rothamsted for taking the photographs of which we have previously been speaking and may soon displace the special cameras even for micro work.)

As examples of photomicrography in the service of agriculture, we may take Figures 3 and 4. The former shows a giant amoeba (single cell) recently isolated from the soil by the Soil Microbiology Department, who have discovered that it feeds on certain types of soil bacteria. Previously these amoebae were thought to be rather rare, but the Rothamsted soil microbiologists have shown that previous attempts failed to isolate them because they were not supplied with the correct nutriment. It is now found that they are relatively common—at least 30 per ounce of soil. As they are very big indeed (250,000 times as big as an ordinary soil amoeba, of which there are about 7½ million per ounce), their discovery, even in these comparatively small numbers, about doubles the weight of amoebae known to be present in the soil.

One of the first essentials in studying a newly isolated type of organism is to work out its life history, and the photograph is one of those which would be taken to record the life cycle and behaviour. The amoeba on the right has almost finished dividing into two daughter cells. A large number of similar photographs and others at higher magnifications make up a complete record.

Of the agents which attack plants and cause disease, some of the most important are the viruses. The annual losses from virus diseases in the potato crop alone run into tens of thousands of tons, and almost all commercial crops are subject to at least one virus disease. Whether a virus is living or not is a question outside the present discussion ; it is sufficient to remark that although they have many of the characteristics of bacteria, they can be crystallized just as can cane sugar or common salt. Some of the first virus crystals ever made were prepared by Bawden and Pirie of Rothamsted. These crystals are mostly quite small, and it is necessary to examine them under a low-power microscope. It is thus much easier for demonstration purposes, and essential for permanent record, to photograph them.

Figure 4 shows crystals of Tobacco Necrosis virus ; each crystal contains millions of virus particles. The lower half is taken in ordinary light, and shows that the crystals have rather the shape of a house roof. These crystals have the property of being able to transmit polarized light in certain directions, and the right half of the photograph, taken in polarized light, shows this effect—only those lying in certain ways can be seen. This technique is often of use for identifying crystals when they are mixed with other material.

The Electron Microscope Since Rothamsted received its electron microscope, it has been possible to delve even further into the realms of the minute. An electron microscope is built on the same principle as an ordinary microscope except that the "lenses" are magnets instead of pieces of glass, and the beam of light used

for vision is replaced by a beam of electrons similar to that in the cathode-ray tube of a modern television receiver. The fluorescent screen of the receiver has its counterpart in the microscope on which the magnified image can be seen. Since electrons affect a photographic plate, it is possible to take photographs directly if the screen is swung aside. With this new microscope it is possible to see objects fifty times smaller than could be seen with the best light microscopes.

The electron microscope is being used to examine particles of virus and clays. The fine particles of clay and all virus particles are too small to be seen with an ordinary microscope, but figure 5 shows that the electron microscope makes clay minerals clearly visible. This is a picture of the clay mineral, Halloysite. Until such photographs were available it was not known whether this mineral was rod-like or plate-like, but here it is seen to consist mainly of rods, about one-fifty-millionth of an inch wide. A whole series of such photographs of known clay minerals would greatly assist in identifying them in clays, and would considerably simplify many of the laborious tests which have at present to be carried out.

It would be possible to describe the use of photography in spectrographic analysis of soils, fertilizers and plants, and in the X-ray analysis of clay minerals, but space does not permit. However, enough has been said to give some idea of the continuous use of this very important technique. It is useful in every branch of research, and such is its flexibility that one photograph may cover the billionth part of a square inch in the electron microscope or several acres in an aerial photograph.

ALTERNARIA BLIGHT OF TOMATOES

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In the course of a visit on September 22, 1944, to a plantation of 1¼ acres of outdoor tomatoes (vars. Potentate, Ailsa Craig and E.S.1.) on a nursery at Ramsgate, Kent, it was noticed that most of the leaves were dead and shrivelled ; the stems were covered with dark brown patches and spots, and many of the fruits were dropping and rotting. From a distance the appearance of the plantation suggested a disastrous attack of Blight (*Phytophthora infestans* (Mont.) de Bary). Closer examination of specimens in the field and in the laboratory proved, however, that the disease was caused by *Alternaria Solani* (Ell. & Mart.) Sor. emend. Jones & Grout*, a fungus which is well known to be responsible for damage to the tomato crop in the U.S.A., Australia, and in some European countries.

A few days later, specimens of foliage and fruit attacked by *A. Solani* were received from a nursery in West Sussex, where similar damage to that described above had been found.†

The fungus in both these instances was critically examined and was found to agree in its characters with those described for the species, in the symptoms it produced on the plants, and in its production of a wine-red colour in the agar medium of cultures. In past years there have been occasional records of this fungus on tomato in the British Isles, but all these, where descriptions and illustrations have been available, can be dismissed as having been concerned with fungi other than *A. Solani* (E. & M.)

* *Alternaria Solani* was formerly named *Macrosporium Solani* Ellis & Martin.

† Information subsequently reached us from Mr. W. Buddin, Advisory Mycologist in the Southern Province, that the disease had also been discovered in mid-September in a one-acre plantation of tomatoes in the Isle of Wight.

Sor. emend. Jones & Grout. Possible exceptions are one or two records contained in mere lists of diseases of tomato fruits. They lack description and detail and thus their value cannot be ascertained. Textbooks on plant pathology published in England contain statements that *Alternaria* Blight occurs on tomatoes in this country, but there seems to be no previously published description of outbreaks. Miss E. M. Wakefield informs us that no British specimens of the fungus on tomato exist in the Herbarium, Royal Botanic Gardens, Kew, and Mr. J. Ramsbottom that he has been unable to find any record of specimens at the British Museum (Natural History), London.

The present writers therefore consider it important now to record that *Alternaria Solani* was present in the south and south-east of England in 1944 and, presumably for the first time in Britain, it caused serious damage to leaves and stems as well as fruits of outdoor tomatoes.

Symptoms On those leaf blades which had not been killed, spots of infected tissue were dark brown in colour and commonly angular in outline. Within these were concentric ridges which have given rise in other countries to the name "Target Spot" (Fig. 1 facing p. 409). The smallest spots measured about 5×3 mm., but larger spots (about 10×7 mm.) were common. They appeared to have no particular distribution and were to be seen at the margins, including the apex, and in the centre of the lamina. Large patches of diseased tissue were formed by coalescence, until finally the whole leaf was brown, shrivelled and dead; most of the plants bore leaves in this latter condition when the nursery was visited.

Stem lesions were oval and most commonly measured about 2×1.5 mm., but the smallest were little more than pin-head size. Larger ones, up to 5×2 mm., were present, and the coalescence of a number of these formed brown streaks and patches, often as much as 12–13 cm. long. Individual spots were sunken and dark brown in colour, with a raised centre of light grey dead tissue (Fig. 2). A striking feature was the greater intensity of infection on the side of the stem which faced the prevailing south-west wind.

On leaf stalks and fruiting branches, the attack resulted in dark brown spots similar to those on the stem but with a greater tendency to coalesce and so form streaks.

The fruit was most commonly infected just beneath the calyx, where at first a dark brown pocket of tissue developed. Spread of the fungus from this point continued until nearly the whole of the calyx half of the fruit was involved. At this advanced stage the tissue was shrunken and the surface wrinkled and black with a copious velvet-like growth of the fruiting fungus (Fig. 3); the rotting fruit readily separated from the calyx.* Lesions occasionally developed at other points on the fruits.†

Spores (conidia), visible only under a microscope, were freely produced on all diseased tissue but were most abundant on the fruit.

* As damage to the fruit is also caused by certain other fungi, particularly *Didymella Lycopersici*, *Botrytis cinerea*, and *Phytophthora infestans*, it is necessary to identify the fungus to confirm the field symptoms when fruit drop occurs.

† In addition to *Alternaria Solani*, another species, *Macrosporium tomato* Cooke, is recognized in America as attacking leaf, stem and fruit. It causes leaf and stem symptoms indistinguishable from those induced by *A. Solani*. The damage to the fruit is, however, different, and is known as "Nailhead Spot" on account of the small, circular, slightly sunken, greyish-brown to brown superficial spots which are fancifully described as resembling nailheads.

Direct attack on the fruit by the fungus, as described above, was not the only way in which fruit drop was caused. Where the whole or part of a fruiting branch had been killed, shrivelling of the stalks soon followed, and there was a tendency for the fruit to separate from the truss just above the calyx at the usual point of picking; so that fruit, with calyx and stalk, dropped to the ground.

Loss All three varieties were equally attacked. The grower had first noticed the disease at the end of August, so nearly all the foliage must have been killed within two or three weeks. Loss of yield was caused partly by damage to the leaves, with consequent failure of fruit development, and also by fruit drop and fruit rot. Owing to the lateness of the attack, it is improbable that death of the leaves had very much influence on the yield, but fruit rot and fruit drop were more serious. The proportion of the total crop lost in this way could not be ascertained because damaged fruits were discarded by the pickers daily and no account of the quantity had been kept.

The Disease in the U.S.A. The most complete accounts of the disease caused by *A. Solani* are based on observations made in the Southern States of the U.S.A., where total loss of crops has not infrequently been reported. In America, in addition to the effects already described above as having occurred in England, it is found that plants may be attacked at all stages of growth from the seedling state until maturity. Also a typical canker may be formed on the stem at soil level causing death of the plant. In America the name "Early Blight" has been given to the disease to distinguish it from Late Blight (*Phytophthora infestans*). The American name may prove to be inapplicable in Great Britain, unless in future years attacks start earlier than did those described in this article.

Source of Fungus and Spread So far, no evidence has been found as to the source of the outbreaks of the disease in Southern England. Leaf spots of potato caused by the same pathogen have been reported from time to time in several counties*, and it is not impossible that nearby infected potato plants provided the original inoculum. However unlikely it may seem that the disease could be seed borne, chiefly because infected fruits would obviously be discarded, this contingency must not be overlooked. J. H. Miller and W. F. Crosier† found evidence that the fungus was carried both externally and internally by the seed, and concluded that commercial seeds were the chief source of primary infection rather than soil or plant debris from a previous diseased crop. Other authors state that the fungus may be carried over from season to season in the remains of dead plants, in the soil or on related crop plants and weeds.

Once the fungus has obtained a footing, spores are freely produced if conditions are favourable, and these are spread to neighbouring plants by means of wind and rain. Abundant moisture and high temperatures favour the disease. With reference to distance of spread, the present writers inspected a tomato plantation on another nursery which was no more than 400 yards from that attacked by *A. Solani*. No sign of the disease could be found. At this second nursery the variety was one of the grower's own selection and was unnamed.

* Moore, W. C., Diseases of Crop Plants, (1943) *Ministry of Agriculture Bulletin* No. 126, 17.

† *Proc. Ass. Off. Seed Anal. N. Amer.*, 1936, 109–111.

Prevention and Control. In the absence of any research work on the disease under British conditions, suggestions as to prevention and control must be based on American experience. Briefly, these include the burning of infected plant debris, crop rotation, the use of seed from healthy fruits only, and the avoidance of planting near to potato crops. These measures will help to prevent not only attacks by *A. Solani* but also by certain other pathogens. Several applications of wet Bordeaux mixture have been found to give satisfactory protection to the foliage. In the U.S.A., where the disease may begin early, the first spraying is given as soon as the plants are set out in the field ; until more is known about the time of first infection in this country, there can be little guidance offered to the grower on this point, but it is probable that the first week in July, as is recommended in south-east England for Blight (*Phytophthora infestans*), would be early enough. In this connexion it is of interest that the infected crop at Ramsgate had been dusted at least ten times with a proprietary copper lime dust, but the grower pointed out that much of this had been washed off by rain and regular watering by overhead pipes. Home-made Bordeaux mixture would have resisted this treatment.

CLUB ROOT DISEASE

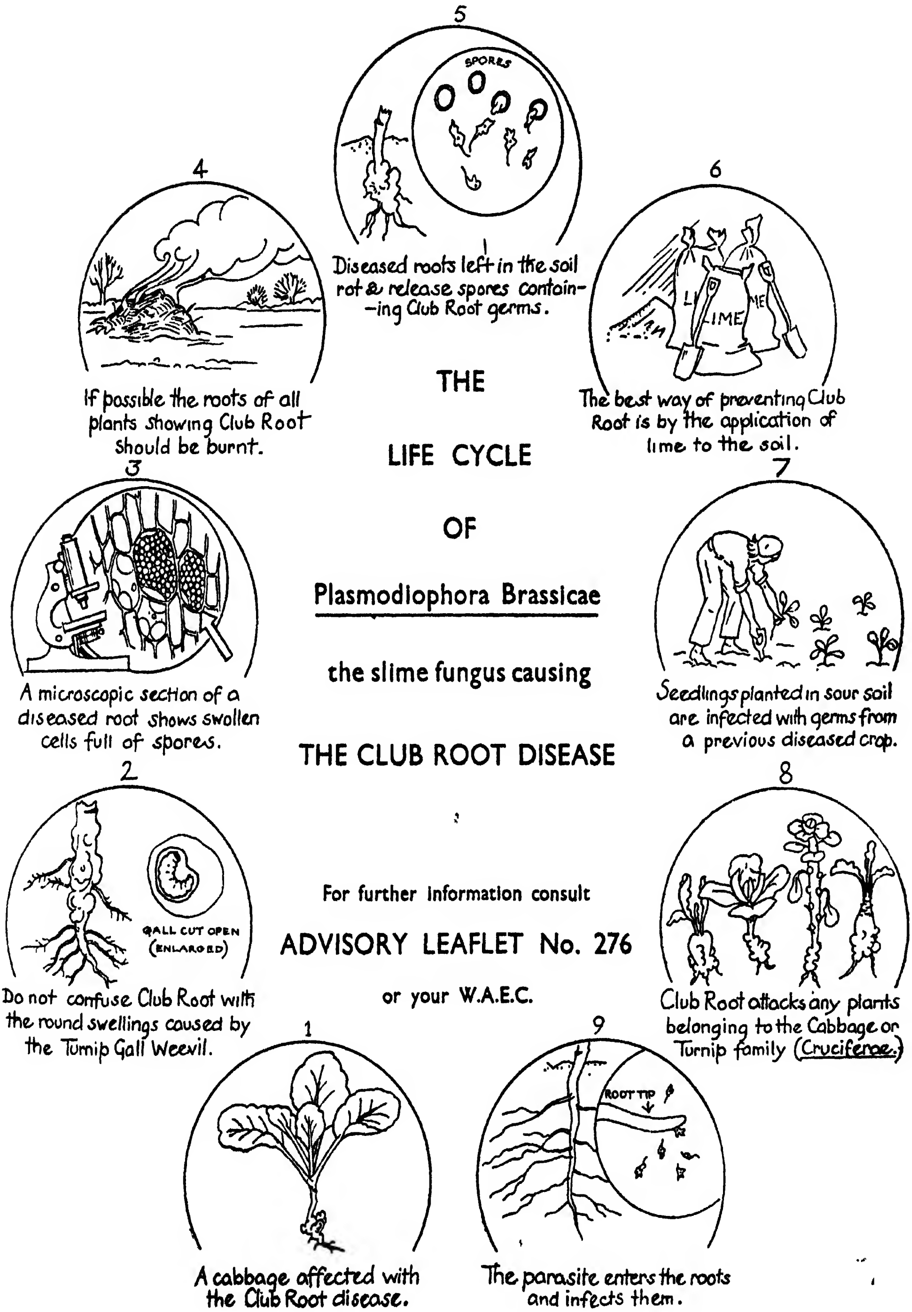
W. A. R. Dillon Weston, M.A., Ph.D.

School of Agriculture, Cambridge

CLUB ROOT, also called Finger-and-Toe disease, is caused by the minute parasitic organism *Plasmodiophora Brassicae*. It attacks only those plants belonging to the family *Cruciferae*. Swedes, turnips, rape, cabbage, cauliflowers, brussels sprouts and mustard are the crops most commonly affected, and weeds such as charlock, wild radish and shepherd's purse.

Root Swellings The symptoms of Club Root are nodule-like swellings on the root system, but these should not be confused with galls formed by the Turnip Gall Weevil. The parasite causing Club Root cannot be seen with the naked eye, but the young galls caused by the weevil each contain a maggot, which can be seen if the galls are cut open. When fully fed these maggots eat their way out and leave conspicuous holes. The damage done by the Turnip Gall Weevil is usually slight, but plants affected with Club Root become sickly and stunted and the root system decays. When the swellings on the diseased roots break down, the spores of the Club Root parasite are released and contaminate the soil.

Prevention of Spread If possible, therefore, the roots of all diseased plants should be burnt. In gardens and allotments this can be done, but it is usually impracticable on a farm. Here, therefore, the first consideration is to see that the parasite is not spread to other fields, and then to remedy the condition on the affected field.


THE
LIFE CYCLE
OF
Plasmodiophora Brassicae
the slime fungus causing
THE CLUB ROOT DISEASE
For further information consult
ADVISORY LEAFLET No. 276
or your W.A.E.C.
1
A cabbage affected with the Club Root disease.
2
GALL CUT OPEN (ENLARGED)
Do not confuse Club Root with the round swellings caused by the Turnip Gall Weevil.
3
A microscopic section of a diseased root shows swollen cells full of spores.
4
If possible the roots of all plants showing Club Root should be burnt.
5
SPORES
Diseased roots left in the soil rot & release spores containing Club Root germs.
6
LIME
The best way of preventing Club Root is by the application of lime to the soil.
7
Seedlings planted in sour soil are infected with germs from a previous diseased crop.
8
Club Root attacks any plants belonging to the Cabbage or Turnip family (Cruciferae.)
9
ROOT TIP
The parasite enters the roots and infects them.

Rotten roots and the dung from animals fed on a diseased crop should never reach the manure heap, for the dung of cattle and sheep fed on diseased roots contains living spores which may remain alive for several years. A diseased root crop should preferably be fed off on the affected field, but if it must be carried away, it is best taken to a permanent pasture or to a field that is not likely to be broken up for some years.

Sometimes the disease is introduced by infected roots of young plants purchased for transplanting. It should be noted, however, that under the Sale of Diseased Plants (Amendment) Order of 1941, plants substantially affected with Club Root may not be sold for planting purposes.

Remedy is Lime It has long been known that sourness of the soil favours Club Root, and that the only satisfactory way of keeping the disease permanently at bay is by the application of lime to the soil. Freshly slaked burnt lime, hydrated lime or ground quick lime, is best. Chalk, ground limestone, and other forms of 'lime" are not so good. The lime should be given as soon as the crop is cleared, but it must be applied in a finely divided state and intimately mixed with the soil particles. There are disadvantages about applying large quantities of lime to the soil, and where Club Root is troublesome growers should apply to their local advisory centre for guidance.

As long a period as possible should be allowed to elapse before again planting a cruciferous crop, and the use of acid fertilizers must be avoided.

COLD WEATHER TRACTOR OPERATION

National Institute of Agricultural Engineering, Askham Bryan, York

AT this season of the year the tractor is likely to do most of its stationary belt work and carting. These usually take only a fraction of the full power of the engine, and if the tractor is exposed to cold winds it often does not run very satisfactorily. The tractor may suffer damage from excessive dilution of the lubricating oil with fuel, and frequently the plugs oil up. Attempts to overcome this by mixing petrol with the fuel are misguided; the engine runs mainly on the petrol, and the vaporizing oil goes straight to the crankcase.

The following precautions will help to keep the tractor in good condition when doing light work in winter:

1. If there is a heat valve in the manifold, turn it to the hottest position.
2. Fit a manifold shield. A piece of sheet metal bent round the manifold and secured under a convenient nut will do.
3. Use the radiator blind or cover the radiator with plywood, stout cardboard or thick material, and adjust until only enough is exposed to prevent actual boiling.
4. On a Fordson, wait until the tractor is hot, and screw down the fuel needle until the tractor begins to misfire. Then ease back just enough to give steady running. This will help to keep up the temperature.

Belt Work (a) Do not place the tractor in an exposed position away from the buildings. If you must do so, put some form of protection such as a sheet of corrugated iron on the windward side.

(b) Do not leave the machine you are driving running idle for long periods; keep it constantly at work.

Carting Try to stand the tractor in shelter while loading or unloading; if you cannot do this, place the tractor tail to the wind. The worst thing you can do is to leave it idling for a long period with a cold wind blowing on the vaporizer side.

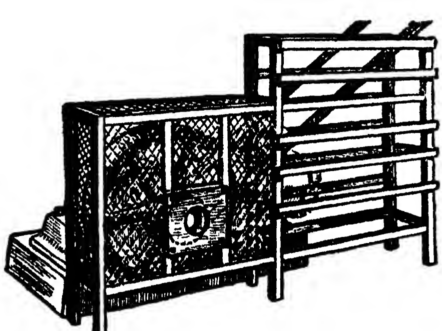
Finally, after a period of belt work or carting try to give the tractor a good spell of hard work. This will evaporate the fuel which has collected in the crankcase before it can do any harm.

PREVENTION OF ACCIDENTS WITH FARM MACHINERY

THE great use nowadays of machinery on farms involves a considerable risk of accidents. Therefore every farmer and farm worker should use machinery with care and take every precaution possible. The accidents are due to a variety of causes, among which are unprotected dangerous parts of running machinery, and carelessness of both experienced and inexperienced operators and their ignorance of the dangerous possibilities. Attention is called here to some of the more important matters of which everybody on the farm should be fully aware.

Stationary Engines

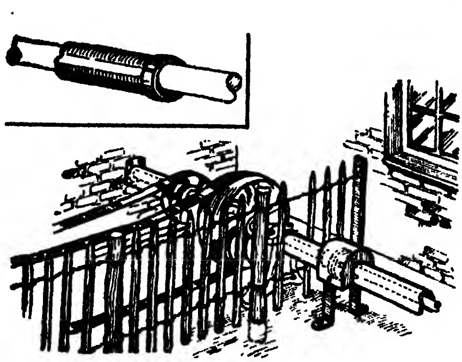
Many fatal and other accidents have been caused on farms by even small engines. Flywheels, projecting ends of crank-shafts, pulleys, driving belts and other dangerous parts should be securely fenced. This should be done whether the engine is in a separate engine house or not. Fencing should be so constructed that there are no traps left for the unwary; for instance, openings should never be left through which a hand may slip against rotating parts. The fencing should be so arranged that when starting the engine nothing need be removed except the guard cover for the shaft end.



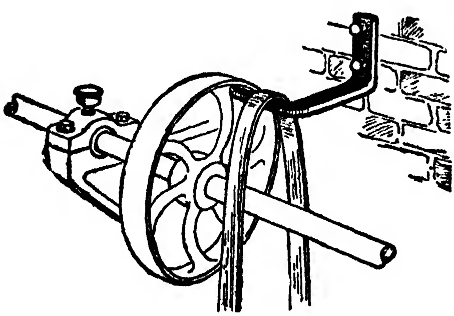
Shafting

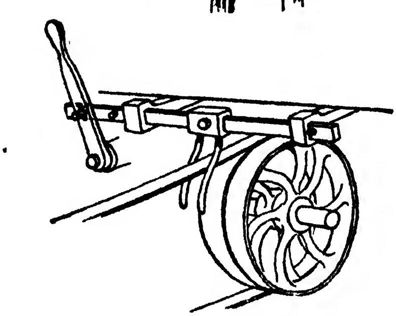
All revolving shafting is dangerous. If a loose end of clothing or hair begins to lap, the worker will quickly become entangled, with disastrous

results. If the shafting carries couplings, collar screws or other projections the danger is increased. Shafting, whether with or without projections, should therefore be fenced off. If placed high enough in a building to be well out of reach, and if other care is taken to ensure that the running shafting is not approached, as by climbing a ladder, fencing may not be necessary. If, however, material is stacked under the shafting so that by climbing upon it the shafting can be reached, then fencing should be erected. Workers should be warned that clothing, sacks or other loose material can easily get caught. In certain circumstances the end of shafting is left exposed. This should never be; it should be guarded equally with the rest of the shafting. On no account should belts be removed or lubrication carried out while shafting is in motion.



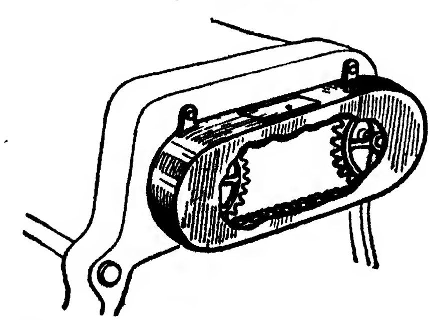
The inset shows how lengths of shafting can be protected by loose sleeve guards of millboard or other suitable material.





Belts and Pulleys

Flat and V-belt drives should be securely guarded and the fencing should be carried up to a suitable height. The nip of the belt on the pulley and projecting belt fasteners are particularly dangerous. Idle belts should never be allowed to hang on a revolving shaft; a belt hanger should be provided for supporting the belt clear of the shaft. Belt-driven machines fitted with fast and loose pulleys and an efficient belt striking gear offer less risk than do machines not so provided.



Chain and Gear Drives

Chain drives and accessible toothed gearing should be totally enclosed by well-made and strong guards. These should never be out of place when the machinery is running.

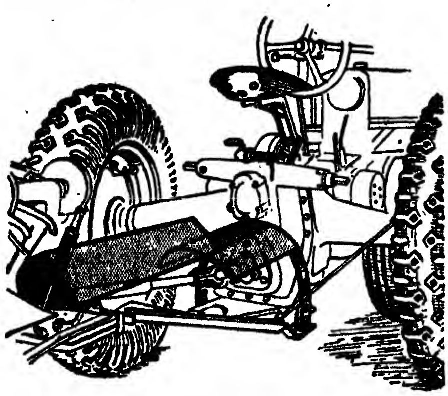
PREVENTION OF ACCIDENTS WITH FARM MACHINERY

General

Plenty of room should be left between and around all barn machinery.

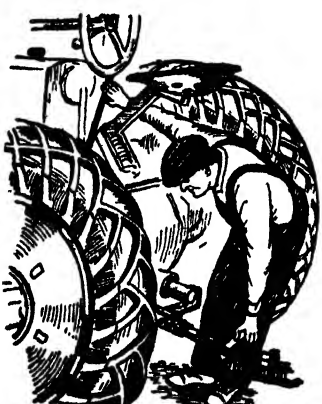
Good natural and artificial light should be provided. All floors near machines should have sound, even surfaces.

Power Take-off Shafts



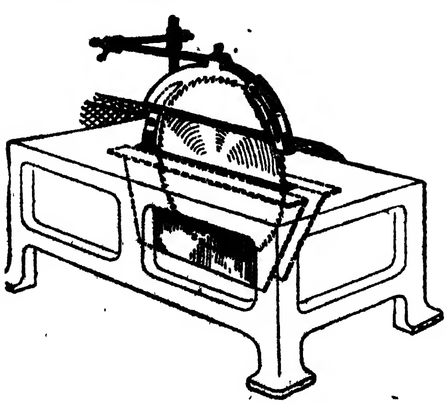
Many accidents have happened with unguarded shafts of binders, combine harvesters and similar machines. Power take-off shafts should never be used without adequate guards. The tractor and the machine should be put out of gear before any adjustments are made, and the shafts should be run as straight as possible to reduce risk of breaking, and resulting injury to the tractor driver.

Hitching Implements on to Tractors



Accidents are caused by neglect to take reasonable precautions when coupling to a machine. Except when the tractor is fitted with controls for safe operation from the ground (as in the illustration), it should not be moved unless the driver is seated at the controls; the tractor should be backed very slowly up to the draw-bar. If an assistant is required to hold the draw-bar of the implement he must not kneel down, but should place himself so that he can move away rapidly if something goes wrong.

Circular Saws



Circular saws are very dangerous machines, and suitable guards should always be used. For the upper part there should be an adjustable cover guard, set as closely to the bench and saw as the work allows. The lower part of the saw, unless fenced by semi-circular plates within the bench—the best modern practice—should be protected by panelling-in the open framework. Sawdust must be removed only when the saw is stationary. A firmly fixed, curved riving knife of taper section should always be used behind the saw to prevent the

timber from closing on it and being flung back towards the operator. Strong push sticks should be used to keep the man's hands away from the saw. The correct type of circular saw should be used for the job—a cross-cut saw for cross-cutting and a rip saw for ripping.

Electrical Equipment

All wiring should be installed and maintained by reliable contractors. New wiring connected to a public electricity supply may not be put into use by a farmer until the Supply Authority has inspected it. Before fuses are withdrawn or replaced, or repairs started, the current should be switched off at the mains. The metal cases of portable apparatus should be sufficiently earthed by means of 3-core cable and 3-pin wall plugs. Such apparatus should never be connected to a lamp socket.

Other Machinery

Such machines as threshers, balers, and silage cutter-blowers, which are moved from place to place, present greater difficulties, but safety precautions should not be neglected. Temporary fencing may be employed in front of shafts, pulleys, driving belts, etc., but the work should be planned so that it is unnecessary for workers to pass near them. Failing other protection, moving parts should be roped off before starting up the plant, so that it is impossible for workers who may be unsighted while carrying straw or similar bulky material to come into accidental contact with them.

Workers should be warned in advance of possible dangers and instructed to work the machinery in a safe manner.

Care of Boilers

Boilers should always be insured with a recognized insurance company, to ensure regular inspection by a competent engineer. Explosions are chiefly due to shortage of water, arising from inattention to water-gauges and feed arrangements and overheating, the result of neglected cleaning. The setting of safety valves should never be tampered with.

First-aid Kit

Every farm should have a first-aid kit, which should be kept in a prominent position, known to all workers. The kit should be periodically inspected to see that it is in good order, and any deficiencies should be made good at once, so that it is always fully stocked. It is an advantage to keep the first-aid equipment near a source of clean, running water.

STATUTORY REQUIREMENTS APPLICABLE TO FARM PLANT

Threshing Machines Act, 1878, and Chaff-cutting Machines (Accidents) Act, 1897

These Acts require that, so far as is reasonably practicable and consistent with the due and efficient working of the machine, the drum and feeding mouth of every threshing machine and the flywheel and knives of every chaff-cutting machine shall be kept sufficiently and securely fenced at all times when working. In addition it is required that the feeding mouth or box of every chaff-cutting machine shall be constructed so as to prevent the hand or arm of the worker feeding it from being drawn between the rollers to the knives. A penalty of £5 may be imposed for non-compliance with either of these Acts.

Boiler Explosions Acts, 1882 and 1890

These Acts require that the owner of any boiler must notify the Board of Trade within 24 hours of the occurrence of any explosion. Failure to report an explosion renders the owner of a boiler liable to a penalty of £20.

FARMING NOTES

Organic and Mineral Fertilizers Dr. E. J. Salisbury, writing in the October issue of the *Journal of the Royal Horticultural Society,* draws attention to the many exaggerated claims made by the muck protagonists for the virtues of organic manures as against "artificials" in the soil. Frequently they assert a distinction between the two which is totally unwarranted by the facts. "Even to-day," he says, "amongst the so-called educated, superstition is hard in dying, and those especially whose education has been neglected on the scientific side, or who have mistaken information for knowledge, are tempted to ascribe mysterious attributes to the unexplored. Just as our primitive forefathers peopled the untraversed forests and mountains with spirits of good and evil, so in these more sophisticated times the organic material in the soil is endowed with almost magical properties that to some appear plausible since its nature is incompletely known."

That the presence of adequate organic material in the soil is supremely valuable, no one will deny, but its true function is often misunderstood. Humus, which is the basis of organic fertilizers, consists of the decayed remains of plants and animals, the cellular structure of which is ultimately broken down to the colloidal state. In this very fine state the particles are so small that the physical properties become more important than their precise chemical nature, which is very complex and naturally varies widely with the raw organic material from which it was derived.

The one outstanding feature of organic material is its ability to augment the soil's capacity to retain water and nutrient solutions. Thus organic matter in the soil is a practical convenience rather than an absolute necessity (it will be remembered that it is possible to grow plants quite successfully on washed sand without any organic material, provided the requisite nutrients are supplied and aeration is maintained).

Dr. Salisbury concludes: "Seen in its proper relation to the mineral nutrients, the organic fraction is in no sense a substitute for them but a means *inter alia* of rendering them more effectively available". Their relationship is complementary.

Vaccination of Calves against Contagious Abortion Vaccination offers the best means of controlling contagious abortion, and the Ministry hopes, therefore, that every dairy farmer will take full advantage of the voluntary scheme which came into operation on December 1.

The charge to the farmer will be one shilling per calf, and the vaccination will be carried out when a veterinary inspector visits the farm for the purpose of inspecting the dairy herd.

The Ministry's No. 1 vaccine made from Strain 19 will be used for the purposes of the scheme. Experience in the United States of America has shown that the vaccination of heifer calves over the age of four months with vaccine made from this strain confers a high degree of immunity from

contagious abortion, extending over several calvings. Experiments, as well as field experience in Britain, have shown that vaccine prepared from the same strain is at least equally as effective when heifers are vaccinated later than the age of calfhood.

The use of a live Brucella abortus vaccine in herds in England and Wales licensed for the production of Tuberculin Tested milk has for the past two years been limited to infected herds, and then only with one of two approved vaccines. The Ministry's No. 1 vaccine may now be used in these herds for both heifer calves and older female animals whether the herd is infected or not. In Scotland, animals in herds licensed for the production of Certified or Tuberculin Tested milk may be vaccinated with live Brucella abortus with the consent of the local authority.

Hedge Renovation "Plashing" and "laying" are synonymous terms used to describe the renovation of partly worn-out hedges, or the reshaping of hedges which have grown too tall and straggly The work, if it is to be done well, calls for skill and considerable practice.

Mr. C. Turner of Brockenhurst, in the New Forest, has described the operation. First, all dead wood must be removed, then the sprawling side growths pruned back and the main stems of the hedge cut partly through. The work is best done by working from one end or from a broken part of the hedge, so that all growths lie in more or less the same direction. If done correctly there is practically an equality of sap and vigour left in the laid growths and the rootstocks, from which new shoots will arise to refurnish the hedge with healthy growth. In this way a hedge that has become very thin at the bottom, or too tall, will be rejuvenated in a year or so. Most likely it will be found necessary to peg down a plashed growth here and there along the length of the hedge.

STAKING The newly laid growths are then intertwined between stakes which are driven in at intervals along the whole length of the treated hedge to give rigidity to the structure. The stakes are sometimes obtained from the strongest limbs in the hedge being treated.

Most growths will be found pliable enough to be bent. Those which are too strong can be eased by a fresh or deeper cut with the chopper or bill-hook. Branches bent over will produce an abundance of new shoots giving the required bushiness at the base. Hedges can be "layed" to any desired height, but vigour must be taken into consideration. A good job will naturally require a measure of uniformity in the finished general appearance. When complete the ditch should be cleaned and the decaying vegetable matter and soil placed firmly on the bank to encourage additional root action by the hedge plants.

Gaps in a hedge can also be dealt with effectively by careful laying of convenient growths in position.

Durham Speaks for Itself Mr. Ted Wright, of Elton, Durham, had some good advice to give on competition ploughing when he took part in the *Country Magazine* broadcast on Sunday, November 5 (B.B.C. Home-Service). The points for which the judges look are straightness, neatness and evenness. "For competition ploughing," he said, "your furrows should measure square. If it's ploughed perfect, you shouldn't be able to tell whether the plough has gone up or down the furrow." But the most difficult thing is getting a good start. He should know, since he has been ploughing from the time he was eleven years old. At fourteen he was competing, and he has had the distinction of winning a ploughing contest twelve times in succession. His own predilection is for horses, but he admitted that a tractor is a lot quicker.

Mr. J. Armstrong, who farms at Westerton, in the same broadcast spoke of the greatly increased production of wheat and potatoes in Durham and Northumberland, much of it grown within a stone's throw of the pit heads. Farmers in this area believe in getting the townspeople to come out to the farms to see for themselves what is being done and "how it all works". Obviously this is the best of all ways to stimulate an agriculture consciousness among townsfolk and, by the interest so aroused, it should pay a good dividend in post-war stabilization of the industry.

The Minister of Agriculture made the same point when addressing the Rotary Club of London on November 1 : "I believe," he said, "that in the post-war era industry and agriculture will each have their part to play, and that in playing it each will be of the greatest help to the other. Together, they can, I think, ensure that our nation will continue to prosper and rank as one of the greatest economic powers of the world. In opposition they will, in my view, spell out a dismal and precarious future for our country."

Fruit Spraying Charts Some months ago the Ministry issued two charts depicting in natural colours the chief stages of fruit bud development in fruit trees. One chart dealt with apple and the other with pear, plum and black currant ; and each stage illustrated was given a standard name—for example, Pink Bud, Petal Fall and Fruitlet. One object in issuing the charts was to help growers to choose the best times for carrying out the spraying operations that are essential to secure the maximum output of fruit under war conditions.

A few copies of the charts are still available, and commercial growers who have not yet applied for copies can obtain them, free and post free, from the Ministry's Office at Berri Court Hotel, St. Annes, Lytham St. Annes, Lancs. It is regretted that the charts cannot be supplied to the general public.

THE MINISTRY'S PUBLICATIONS

Since the date of the list published in the September issue of this JOURNAL (p. 287), the undermentioned publications have been issued :

Bulletins Copies are obtainable at the price mentioned from the Sales Offices of H M. Stationery Office or through any bookseller.

No. 37 Ensilage (*Revised*). 1s. net (1s. 2d. by post).
No. 43 Farm and Creamery Cheese-making (*Revised*). 1s. net (1s. 2d. by post).
No. 95 Strawberries (*Revised*). 2s. net (2s. 2d. by post).
No. 128 Wireworms and Food Production (*New*). 1s. net (1s. 2d. by post).

Advisory Leaflets Single copies of not more than 16 leaflets may be obtained, free of charge, on application to the Ministry, Berri Court Hotel, St. Annes, Lytham St. Annes, Lancs. Copies beyond this limit must be purchased from the Sales Offices of H.M. Stationery Office, price 1d. each net (2d. by post), or 9d. net per doz. (11d. by post).

No. 84 Pear and Cherry Sawfly (*Revised*).
No. 212 Nest Boxes (*Reissued*).
No. 266 Clover Rot (*Revised*).
No. 276 Club Root (*Revised*).
No. 320 Poultry Manure (*New*).

"Growmore" Leaflets Single copies of these leaflets may be obtained free on application to the Ministry only (copies are not obtainable from H.M. Stationery Office). The following further issues are now available :

No. 41 When Land Needs Lime (*Revised*).
No. 66 Calf Rearing (*Revised*).
No. 84 Rations for Live Stock—Winter 1944–45 (*Revised*).
No. 91 How to Select a Dairy Bull (*New*).

AGRICULTURAL INDEX NUMBER

MONTHLY INDEX NUMBERS OF PRICES OF AGRICULTURAL PRODUCTS INCLUDING GOVERNMENT GRANTS. (BASE 1927–29 = 100)

Month	Uncorrected for Seasonal Variation 1939	1941	1942	1943	1944	*Corrected for Seasonal Variation* *1939*	*1941*	*1942*	*1943*	*1944*
January	95	149	176	182	191†	*89*	*137*	*162*	*167*	*173†*
February	94	144	179	180	188†	*88*	*135*	*168*	*168*	*173†*
March	91	143	177	174	182†	*91*	*144*	*179*	*173*	*178†*
April	90	138	162	158	164†	*95*	*145*	*172*	*166*	*171†*
May	82	130	155	150	152†	*91*	*147*	*175*	*168*	*171†*
June	80	129	153	149	150†	*89*	*145*	*172*	*166*	*170†*
July	85	137	155	153†	156†	*93*	*148*	*168*	*165†*	*169†*
August	86	140	152	152†	156†	*91*	*147*	*159*	*161†*	*173†*
September	92	140	148	148†	152†	*93*	*143*	*151*	*152†*	*157†*
October	96	155	165	164†		*92*	*148*	*157*	*157†*	
November	106	163	175	174†		*98*	*150*	*162*	*161†*	
December	113	169	180	183†		*103*	*153*	*163*	*166†*	

† Provisional

This Table incorporates certain revisions, the chief of which is the calculation of the allowances made in respect of the acreage payments on potatoes (from July, 1941) and wheat (from August, 1943). In computing the index numbers for these products, allowances are now based on the estimated quantities entering into sale and not, as formerly, on the estimated total production of each of the respective crops. Revisions of other indices have been referred to in previous issues of this JOURNAL.

NOTICES OF BOOKS

The Agriculture of Wales. A. W. ASHBY and I. L. EVANS. University of Wales Press, Cardiff. 15s.

This book of 300 pages, nearly half of which is taken up by statistical appendices and explanatory notes, with much tabular matter and many diagrams in the text in addition, is designed to give a clear picture of Welsh agriculture in its historical setting. As such, it is an invaluable work of reference to everyone concerned with agriculture in the Principality, and the reader will feel grateful to the authors if only for the painstaking task of presenting in one volume a mass of material hitherto widely scattered and undigested. But *The Agriculture of Wales* is much more than a compendium of basic data : facts and figures have been used to focus attention on the wide currents affecting the life of a small community, on that community's heroic reactions to changing conditions, and on the problems which adaptations have hitherto left unsolved. The technical, human and governmental questions raised in this regional survey will concern a wide circle of readers in many walks of life.

Some sections of the book, such as the chapter on Population and Labour, raise many controversial issues, while throughout there are reminders of fundamental features which are frequently ignored or forgotten by those who claim to speak with authority. Thus is it sufficiently realized that over 25 per cent. of Wales is above the 1,000-ft. contour, with another 32 per cent. above the 500-ft. level; that only 10 per cent. of employed persons are engaged in agriculture; that the average holding in Wales is very much smaller than that in England; that two-thirds of hill sheep flocks carry less than 100 ewes and shearlings; that in a country where 95 per cent. of the income is derived from live stock and their products, one-half of the farmers were liquid milk sellers even in 1938; that the average tillage area per working horse was only four acres in 1939; that over the period of review there has been a substantial decline in crop yields, and that a long-established co-operative system has had to be buttressed by statutory marketing schemes?

The book is an excellent example of the purposeful collection of information and analysis of research, and Professor Ashby and Principal Evans are to be congratulated on their partnership. The appearance of the book is most timely now that the many problems of post-war agriculture are becoming matters of immediate practical interest.

NOTICES OF BOOKS

British Agriculture (British Life and Thought Series). LAURENCE F. EASTERBROOK. Longmans Green & Co. 1*s.*

'The promotion of amity between nations depends essentially upon mutual understanding. The greater and more prolific the interchange of literature designed to this end, the more secure will be the foundations of a lasting world peace. This series of booklets, issued by the British Council under the title of *British Life and Thought,* are well calculated to explain the economic and social characteristics of the people in this tight little island; and not least of these, either in value or interest, is the booklet under review.

Mr. Easterbrook has presented a highly commendable and succinct account of British agriculture, from the primitive activities of Neolithic times to the highly organized industry which it is to-day. Admittedly it is but an outline, yet it is sufficient to throw into relief the pattern of our war-time farming organization, and to show quite clearly that the agricultural decline since 1880 has been arrested to such good purpose in the past five years that a permanent and prosperous place for agriculture in the national economy is something more than a pious hope.

The domination of arable farming to-day over the "ranching" of yesterday has changed the face of British farming; and the farmers themselves, as the author shows, have not been slow to learn the new technique through the means provided by the State. By their efforts some 5–6 million tons of shipping space a year have been released for other war purposes. But this would never have been accomplished had it not been for the generous help which the U.S.A. and the Dominions have given with farm machinery—supplementing home manufacture. The increased mechanization of British agriculture constitutes one of the major revolutions of the century. Despite the fact that some 40,000 skilled agricultural workers have been called to the fighting forces, many thousands of acres of both marginal and sub-marginal land have been mobilized for food production.

In the epilogue to this brochure, Mr. Easterbrook shows that the ultimate goal of British agriculture is to take a full and responsible place in world co-operative plans to implement the Atlantic Charter and the resolutions of the Hot Springs Conference—"a philosophy of plenty" as he calls it.

> "When people are hungry or badly frustrated, they tend to turn to physical violence, and if a powerful nation runs amuck it in its turn infects others with its mania. If, therefore, we are to abolish war, we must abolish these economic causes of war."

Throughout the 4,000 years history of British agriculture our soil has never been exploited, so that to-day it is as productive as ever. Our duty is to pass it on in good heart. Looking to the future the author formulates a creed: "We believe," he says, "that an agriculture based upon the care of the soil, sustained by prices that ensure to the efficient farmer a fair reward, and inspired by a spirit of service to the land and to those who look to it for their daily bread, can create the good life".

No one will disagree with that.

The Clifton Park System of Farming. (2nd Edition). ROBERT H. ELLIOT. Faber and Faber. 12*s.* 6*d.*

In prompting the reprint of Robert Elliot's *Clifton Park System of Farming,* Michael Graham has rendered good service to all concerned with agriculture; the book has often been asked for in vain during recent years. In its new edition the introduction by Sir George Stapledon links the original and present-day approaches to the ley system. Quite naturally the introducer has stressed the author's demand for State-aided research, but to the practical man, Elliot's own work, so aptly and minutely described, has probably the greater appeal. Elliot's experimental technique was not favoured by the authorities, but it achieved results; and that, after all, is the ultimate criterion of all research.

The ley system of farming is likely to be put to a crucial test in the next few years as agriculture changes over from war to a peace footing, and a close study of Elliot's methods may bridge many of the gaps in the structure of ley farming as we know it at the moment. Not the least of these is the development of drought-resistant plants, particularly grasses; and his championship of cocksfoot is very opportune. One wonders what he would have done with this grass if he had been able to use the present pedigree strains. His use of other less well-known grasses and herbage plants points the way to further investigation. This seems specially desirable now that parts of Britain are periodically subjected to severe drought, giving rise to the criticism that leys give an "all or none" pasture supply. The deep-rooted plants, particularly those which we call "herbs," may also have a part to play in animal health. Elliot's work with a wide range of herbage plants is well worth further study. Elliot was a student of public affairs as well as of pasture plants—a man before his time, whose real worth is only now beginning to be appreciated.

NOTICES OF BOOKS

Cabbages and Committees. DUNCAN MCGUFFIE. Faber and Faber. 7s. 6d.

It is evident that *Cabbages and Committees* was written by a young man seeking to reach the essential principles of growing. He appreciates that in two, ten or twenty years he may be thinking on different lines and willingly acknowledges that some of his opinions have already altered.

Mr. McGuffie is a keen observer, bringing all his faculties to bear upon the problem in hand; seeing, hearing and sensing the important "trivialities" of a farmer's daily round. One realizes this trait when reading the description of his farmhouse, which he immediately notices has locks of solid brass and doors fitted with rising butts. His observant eye apprises him of the fact that the original building dates back to early seventeenth century, and he judges that the additions and improvements were made at a time when agriculture was enjoying a period of prosperity. So he weaves his little story around his dwelling-house, although the reader is left wondering if the result would not have been different had a feminine touch found a place in the decorations and furnishings.

In summing up the rapid reclamation of his new farm, he attributes the speed with which this was accomplished to three factors: experience, the aid of modern machinery, and the use of organic fertilizers combined with muck. He is evidently working on fundamental lines and has found for himself the three essentials of efficient production: experience, good cultivations, and the use of organic fertilizers.

The Author has no preconceived notions, and possesses the admirable quality of not condemning practices or appliances without investigation. The question arises whether development by trial and error would have been a little less onerous had his training been on different lines.

In the reviewer's opinion, this book is a valuable contribution to horticultural thought, and one which can be freely recommended to every beginner, since it will introduce him to the many difficulties he will encounter and inevitably have to overcome.

How Your Tractor Works. (Power Farmer Publication No. 1). POWER FARMER, 101 Kings Road, Reading. 1*s*.

This is the first of a series of booklets on the use and care of machinery planned by the publishers of the *Power Farmer Monthly*. By means of cleverly simplified drawings the details of the working principles of the tractor are most clearly set out. The booklet, which is edited by D. N. McHardy, N.D.A., A.I.A.E., M.S.E., is divided into four sections: (1) First principles of the Motor; (2) Fuel Vaporization and Engine Temperature; (3) Lubrication and Ignition Systems; (4) Clutch and Transmission.

Each of these sections is dealt with in as much detail as is possible in a pamphlet of this size, and indeed in as much detail as will be desired by a driver to whom the mechanics of the tractor is only one of the many subjects of which he must have a working knowledge. The publication is well calculated to be of the utmost use to all farmers and farm workers who wish to learn how the tractor works and what sort of treatment will call out of it the best and longest service.

The Cattle of Britain. FRANK H. GARNER. Longmans, Green & Co. 18*s*.

This book gives a brief but comprehensive and interesting survey of the history of cattle breeding and management from very early times to the present day. The development of livestock improvement into the main lines of milk and beef is clearly shown, while the chapter on dual-purpose is of importance when "cattle are at the cross-roads". The discussions on the financial returns obtainable are absorbing, and the statistical Tables have been well chosen to illustrate points.

The book should be read and retained for reference by all students of animal husbandry.

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NEW YEAR'S MESSAGE FROM THE MINISTER

WE ALL HOPE that this year will see the defeat of Germany. It is certain that in the years that follow our international financial balance sheet will demand a high level of food production from our own soil. We shall have to continue our present efforts—probably increase them. That is a programme that should challenge our spirit.

Everything points to the need to concentrate more and more on live stock and livestock products, things well suited to our conditions here. At the same time we shall need our present tillage acreage.

For such a programme we must see that we get many things—machinery, fertilizers, labour, cottages, farm buildings, water supplies. But above all we shall need technical knowledge and the will to carry the job through.

I wish A Happy New Year to all our readers.

R. S. Hudson

LAND SETTLEMENT AFTER THE WAR

C. W. SABIN, O.B.E., B.Sc.

BEFORE looking to the future a brief survey of land settlement in the past may help to a better understanding of the subject.

State-assisted land settlement in England and Wales started, for practical purposes, with the passing of the Small Holdings and Allotments Act, 1907, which, in the following year, was consolidated with the Small Holdings Act, 1892 (an ineffective Act) in the Small Holdings and Allotments Act, 1908. This enabled County Councils to provide smallholdings on a self-supporting basis for persons possessing the necessary experience and working capital.

Up to the outbreak of war in 1914, County Councils had, on the whole, been active in providing smallholdings of varying types, ranging from plots of bare land, cultivated as an auxiliary form of occupation by persons having other employment on the land or in nearby villages, to fully equipped holdings up to 50 acres* on which the tenants obtained a full livelihood. Tenants of these smallholdings were recruited, for the most part, among farmers' sons, agricultural workers and village tradesmen. Very few came from the towns.

Up to December 31, 1914, some 12,800 smallholders had been settled, but how many of these derived a full livelihood from their holdings and how many had other occupations is not known.

Land Settlement after First World War At the end of the war the Government of the day, in fulfilment of a pledge to the men serving in the Forces, launched a scheme of land settlement for ex-service men. In the main, this scheme took the form of the provision of smallholdings by the existing Small Holdings Authorities (County Councils and Councils of County Boroughs) under widely extended powers which were given by the Land Settlement (Facilities) Act, 1919. The Minister of Agriculture and Fisheries also obtained statutory powers to undertake direct schemes of land settlement under the Small Holdings (Colonies) Acts, 1916 and 1918.

The years immediately after the last war were years of agricultural prosperity, high prices and high rates of interest on Government borrowings. In so far as prosperity was bound up with high prices for agricultural produce, it rested, as subsequent experience showed, on a very insecure foundation. Nevertheless, while it lasted it greatly stimulated the demand for smallholdings, and there was a rush of applications, many of which came from obviously unsuitable persons. On the other hand, the abnormally high cost of building, together with inflated interest rates, made it inevitable that the cost of providing smallholdings, expressed in terms of interest on the capital cost, plus the cost of annual repairs and management, was far in excess of the rent that the holdings would command when let on reasonable terms.

The number of smallholders settled under the post-war land settlement scheme was about 17,000, and here again, as with the pre-war holdings, a substantial, though not so large, proportion consisted of bare land holdings occupied by men who had some other occupation. In the main, however, it was a scheme of land settlement in the strict sense. The majority of the settlers were men who had had agricultural experience before they joined the Forces. Provision was made for advances of working capital to approved settlers up to a maximum of £1 for £1 of the settler's own capital, repayable over a short period.

* The upper limit of size for a statutory smallholding is 50 acres, or, if in excess of 50 acres, then not exceeding £100 annual value for purposes of income tax.

There was necessarily a considerable loss on the holdings provided under the 1919 land settlement scheme, a loss which was increased by the reduction of rents consequent on the fall of agricultural prices in 1922. The sum total of these losses in every county was repaid by the Ministry annually up to March 31, 1926.

As at that date, a valuation of net annual income and net annual charges for each county authority's Small Holdings undertakings as a whole was made in accordance with the Land Settlement (Facilities) Amendment Act, 1925, whereby the Minister undertook to pay to each County Council the difference between the two figures. In pursuance of this undertaking, the Minister has paid year by year, in respect of some 17,000 smallholdings covering an area of about 250,000 acres, a sum standing in 1926 at £859,990 and diminishing, through the effluxion of short-term loans, to £767,653 in the current year. The figure will continue to diminish year by year until about the year 2000, by which time the long-term loans will have been entirely repaid and the income should cover the expenditure. The pre-1919 smallholdings were included in the valuation, but the majority of these had been provided on a self-supporting basis under much more favourable conditions, and the losses on these, if any, were negligible.

The Small Holdings (Colonies) Acts allowed for the provision by the Minister of smallholdings of the same type as those provided by County Councils under the Small Holdings Act, but, in addition, a small number of farm settlements on a profit-sharing basis were set up by the Minister. These, however, did not prove successful and had a relatively short existence. They were carried on as mixed farms, quite unlike the co-operative farms for market-garden production on intensive lines referred to later. Most of the smallholding settlements were transferred to the appropriate County Councils at the time of the 1926 valuation, but a few are still retained by the Ministry.

A substantial part of the sum advanced to settlers for working capital under the land settlement scheme had to be written off eventually as irrecoverable, owing to the adverse conditions that arose after 1922.

In 1926 a new Small Holdings Act was passed which enabled County Councils and Councils of County Boroughs to provide additional smallholdings for qualified persons possessing the necessary working capital. The financial basis of this scheme was that the Ministry made contributions up to 75 per cent. of the estimated annual loss, the remaining 25 per cent. being provided by the County Council. As compared with what was done under the Acts of 1908 and 1919, operations under the Act of 1926 have been very limited and were suspended altogether on the outbreak of the present war. Up to that time, 2,859 smallholders had been settled on land acquired under the Act.

During the period of severe unemployment in certain parts of England and Wales, particularly among miners, workers in shipyards and in the iron and steel industries, which reached its highest point in 1934, attention was directed to the possibility of alleviating the situation by settling some of the unemployed on the land after a suitable period of training. A Land Settlement Association, having this object, was set up under Government auspices towards the end of 1934 and was given a grant from the Development Fund. Upon the appointment in the same year of a Commissioner for the Special Areas (i.e., the areas of severe unemployment, comprising, in England and Wales, parts of Northumberland and Durham, West Cumberland, South Wales and Monmouth) with power to promote and

assist various ameliorative measures, grants from the Special Areas Fund were allocated to:

(1) A special programme of smallholdings to be undertaken by the Land Settlement Association for the settlement of unemployed men and their families from the Special Areas.

(2) The assistance of smallholdings schemes, promoted by the County Councils of the Special Areas, for similar purposes.

(3) The establishment, under the aegis of a Welsh Land Settlement Society, of a number of settlements of unemployed men in the Special Areas of South Wales. Most of these Welsh settlements took the form of co-operative profit-sharing farms, directed mainly to commercial horticulture on highly specialized lines.

The cost of the smallholdings set up by the Land Settlement Association in England proved very high, the fixed capital, cost of land, dwelling-house, farm buildings, fencing, water supply, etc., having to be supplemented by the advance of sufficient working capital to enable settlers beginning without resources of their own to make a living after an initial period of training.

A survey of the different forms of land settlement for the unemployed up to the outbreak of the present war with much detailed information on the results achieved, the cost of settlement and the prospects of the settlers, will be found in the Report of the Dampier Committee.* It is of some significance that this Committee, after a careful review of the different types of land settlement, decided in favour of the system of co-operative farming adopted by the Welsh Land Settlement Society as opposed to that of individual smallholdings, the system adopted by the Land Settlement Association. At the same time the Committee was careful to explain that their findings must not be held to be a final judgment on the questions referred to it, firstly, because there had not then been sufficient time to test the results, and, secondly, because the settlement schemes dealt with a particular and very limited class of persons, namely, industrial workers suffering from long unemployment and with little or no agricultural experience or background beyond the cultivation of an allotment and, in some cases, the keeping of a few poultry or pigs.

Whatever lessons the past may have to teach in regard to the possibilities and limitations of land settlement, it is certain that the end of the present war will bring a renewed urge for the provision of facilities for settlement. It is essential, if any success in this direction is to be achieved, that would-be settlers on the land should appreciate the hard realities of the situation. The romance which in the minds of many townsmen gathers around the idea of a "little home in the country" with land enough to provide a comfortable living must be put aside. The would-be settler must realize that the countryside, seen in a time of leisure from a railway train or a motor coach on a fine summer afternoon, is not the countryside as it appears to the man who is strenuously engaged all day in wresting a living from the soil. This is the almost inevitable lot of the smallholder and his wife, who can do much to make or mar his success. They must be prepared for a simpler and more rigorous life than that of the artisan living in the town. There will be fewer opportunities for holidays, cinemas and other amenities. But there will be ample compensation for those who are really fond of life in the country, and they alone are the people who should consider such a venture.

* Report on the Committee of Enquiry into Land Settlement (1939). H.M. Stationery Office.

Important Factors in Land Settlement Schemes With this general word of caution it may be well for any potential settler to bear in mind various factors which will have an important bearing on the possibilities of any scheme of settlement. Some of these factors may be enumerated briefly:

(1) Under the stimulus of war-time needs and assured prices, the farmland of this country has been brought to a level of cultivation and productivity far in excess of anything that has been achieved before. There may, therefore, be great difficulty in finding any considerable area of suitable land that the owner or occupier will part with voluntarily for the purpose of settling newcomers on the land.

(2) The first priority call on building labour and materials for some time after the war will be for housing and the reinstatement of essential buildings damaged by war action. The extent to which labour and materials can be made available to the equipment of land settlement schemes is likely to be very limited for some time.

(3) Similarly, there will be a continuing shortage of concentrated feedingstuffs for pigs and poultry, the keeping of which must always form a permanent feature of any scheme of land settlement, at all events on smallholdings.

In view of such considerations as these, it would be a mistake to encourage the hope that the end of the war may provide an opportunity for launching any large-scale scheme of land settlement. It may be presumed that the possibility of a limited, even if no more than an experimental, advance in this direction is engaging the attention of those who are in charge of post-war planning of agriculture and the use of the land.

In considering what form, or forms, any future scheme of land settlement should take, the following are some of the points that seem specially worthy of attention.

(1) Settlement on individual smallholdings, unless the settler can provide his own working capital, is likely to be more expensive than, for example, settlement on a co-operative farm, where all the necessary implements and appliances are provided and held collectively. Moreover, the running of an individual smallholding requires special aptitude. Given this aptitude and the qualities of independence, initiative, energy and resourcefulness, the individual smallholding may give the greatest scope and opportunity for turning the land to the best possible account. Possession of these qualities in an outstanding degree may make a man disinclined to share in a co-operative farm enterprise, in which he would gain little or no advantage from his superior talents and abilities as compared with his fellows.

(2) While settlement on an individual smallholding may appeal to, and be suitable for, the particular type of person who likes to be his own master and does not mind how many hours he works in that capacity, there is, nevertheless, the other type of person who prefers the security of an assured wage, especially with the added attraction of a possible share of profits and more or less regular hours of work and of leisure.

(3) Apart from differences of temperament, which may incline a particular individual towards one rather than the other form of enterprise, it may be observed that the Land Settlement Association found it essential for the success of their undertaking to make the co-operative buying of requisites and the sale of produce obligatory on all its settlers. It is this, more than any other feature, that has enabled the Association to achieve its purpose with a considerable degree of success, and it seems probable that any future scheme of land settlement on individual holdings would have to be based on a system of compulsory co-operation among the smallholders, more especially if they are drawn from the ranks of those who have not had previous experience in the working of a holding. This

compulsory co-operation might make the scheme less attractive to the type of person to whom the occupation of a smallholding would otherwise appeal.

(4) It would seem that there must be a certain loss of efficiency, due first to dividing up the productive unit (the area of land comprised in any one smallholdings estate) into a number of smaller individual units consisting of the actual smallholdings, and then bringing the produce of all the smallholdings together again for the purpose of disposal. It is a debatable point whether this loss of efficiency can be wholly balanced by the greater initiative, industry and energy that the average man may be expected to display when working for himself and not as one of a group. If it cannot, then the presumption is that it would be better to operate a settlement as a single unit, the settlers working for the settlement as a whole under skilled supervision and direction.

(5) The trend of industrial development in the coming years is still obscure. If there should be any substantial migration of industry, particularly of light industry, to the countryside, aided by the general availability of electricity, it may well be that a popular form of land settlement would be the occupation of a plot of, say, $\frac{1}{4}$–$\frac{1}{2}$ acre of land by an industrial employee for growing fruit and vegetables and keeping poultry in his spare time. The tendency of the times is likely to be in the direction of shorter hours of work, giving more time for the management of a plot of this size. "Digging for Victory" will have implanted in many industrial workers a liking for work on the land, even if they do not feel any urge to make it a career and to give up their industrial vocation altogether. Whether this particular type of holding could be dignified by the name of "land settlement" is perhaps open to question, but it should undoubtedly satisfy a real desire without the hazards of a life depending entirely on the land. It should not be overlooked in any future plans that may be under consideration. If these facilities are made available it should be not only for factory workers in rural areas but also for men working on farms. The farm worker of the old type would not perhaps be very anxious to continue the same kind of work in his spare time. But with the progressive mechanization of farming, new classes of work are becoming more common, and the man who is engaged all day on the mechanical side might well be as keen to have a plot of land as a worker in a factory.

(6) This mechanization of agriculture, accelerated as it has been under the stress of war conditions, is a feature that will be more and more marked as time goes on. It has brought and will, in increasing measure, bring to the countryside opportunities of employment on the land for which, with comparatively little training, the mechanic who has had work in the towns will in every way be fitted. The future should, therefore, hold prospects of employment in the care and use of farm machinery which, although not to be confused with land settlement, will, nevertheless, satisfy the same basic need—namely, the association of as large a population as possible with work on the land. Apart from work of this nature, a period of employment as wage earner in purely agricultural work may well afford a suitable means of gaining the necessary experience for an independent career as a smallholder. Agricultural wage rates no longer fall so far short of normal industrial standards as to make such a prospect wholly unattractive to the townsman.

SEEDS MIXTURE TRIALS IN LEICESTERSHIRE

D. H. Findlay, H. R. Kirby and G. R. H. Bishop

Leicestershire War Agricultural Executive Committee

FOR many years grass has been of paramount interest to Leicestershire farmers, and in the period immediately before the war there was little thought of ploughing up permanent pasture. Even in those days, however, some were beginning to take to the plough as a means of improving their poorer grassland.

Since **1939** an intensive ploughing-up campaign has been pursued in this county, and now naturally farmers are turning to direct reseeding and the establishment of leys on arable land as a means of restoring fertility and tackling grassland problems with which they may be faced after the war. The series of seeds mixture trials which has been laid down in conjunction with the Royal Agricultural Society of England and Sir George Stapledon and his colleagues has, therefore, been the subject of keen interest, and the lessons drawn from the trials are already proving of value to farmers in the county.

Trials have been conducted at ten centres, each of which comprises five one-acre plots, as follows :

1939	2 centres	(1) Chalky boulder clay. (2) Glacial gravel
1940.	2 centres	Both on glacial loams but with 300 ft. difference in altitude
1941.	4 centres	(1) Upper lias clay. (2) Middle lias clay. (3) Lower lias clay. (4) Glacial gravel over Keuper.
1942.	2 centres	(1) Lower lias clay. (2) Glacial sand.

In the trials laid down in **1939** and **1940** simple mixtures were used, designed primarily to compare the performance of Aberystwyth strains and certain commercial strains of perennial ryegrass, cocksfoot, timothy and red and white clovers. In the **1941** and **1942** trials plots of New Zealand strains were introduced and more complex mixtures of strains were used. The species, however, remained the same as in the earlier years, except that in the **1941** series meadow fescue was included in one plot at each centre. The average weight of grass mixture sown has been about 24 lb. per acre. Red and white clovers, either singly or in combination, have been included up to 4 lb. per acre. White clover has not been sown at a rate exceeding 2 lb. per acre as a single strain or a combination of strains. In most cases Italian ryegrass has been used as a nurse crop.

Technique At eight of the centres the trials were included in fields which had been broken up from poor, old grass for direct reseeding. The cultivations varied according to local circumstances, but in the main they were on conventional lines, i.e., shallow ploughing of the old turf, followed by discing and rolling until consolidation and tilth were satisfactory. In all cases phosphates and nitrogen were applied and, where necessary, the soil was adequately limed. At one centre the seedbed was prepared by repeated heavy discings of a worn-out pasture without ploughing, and a successful take was obtained.

At two centres the plots were sown on foul old arable land which was being seeded to grass without a nurse crop ; at one of these centres a

thick mat of chickweed developed, which was dealt with by heavy grazing followed by drastic harrowing; at the other centre a dense growth of stinking mayweed threatened to smother the seeds, but this was averted by topping the field with the mower and grazing heavily with cattle. At both these centres the sward developed extremely well and there has been no further trouble with weeds.

In most of the trials the seeds were sown in spring, but at two centres they were not sown until the end of August after a summer fallow. There have been successful takes in all cases except one, in which a very heavy infestation of leatherjackets completely cleared the field. The land was redrilled, however, and the seeds established themselves successfully after the second sowing.

Management As could be expected, the management of the sward has had a marked influence on its development. Early stocking—as soon as possible after sowing—has always been stressed, and this has been done at all centres. Subsequent management of the fields has naturally been governed by the particular needs of the individual farmer on whose land the trials have been conducted. In most cases, however, stocking has been almost continuous throughout the grazing period every year, with periods of rest during the winter.

Two departures from this procedure are of interest:

(1) A cocksfoot trial laid down in 1939 was ryegrass-dominant in the first year (a proportion of perennial ryegrass being constant in all plots). In the second year white clover developed profusely, and in the autumn of that year the field was laid up for a late cut of silage. The period of rest apparently gave the cocksfoot a chance to become established, and this grass has been dominant since that time. Indeed, in this series of plots the habits of S. 143, S. 37, S. 26 and Danish have been demonstrated in a copy-book manner.

(2) At another centre, where hay was taken in the fourth year after reseeding, the sward has deteriorated badly, and there is a marked increase in weed grasses. It seems clear from this and other experiences in the county that the chances of developing a densely knitted, leafy sward are reduced by taking hay during the first few years after sowing. It can be understood why it is an unheard-of thing for a Market Harborough grazier to mow one of his fattening pastures.

Basis of Comparison The conclusions which have been drawn from the trials have been based entirely on observation of the plots at frequent intervals throughout their existence. In view of their excellent performance, the Market Harborough fattening pastures have been regarded as the model of an ideal Leicestershire pasture, and it has been assumed that those strains of grasses and clovers which exhibited the habits seen in these pastures would be the right ones to choose in laying down a ley for grazing purposes.

Our best old pastures are known to consist mainly of perennial ryegrass and wild white clover, with small proportions of cocksfoot and timothy and a minimum of weeds. The species are prostrate in habit and the plants intermingle, giving a closely-knitted, dense, leafy sward, which can be kept closely grazed and yet on which, because of its density, a bullock can fill itself quickly.

Performance of Grasses : (a) SPECIES The grasses under observation were perennial ryegrass, cocksfoot, timothy and meadow fescue, the rates of seeding being adjusted so that on individual plots a particular grass would have the opportunity of developing into the dominant species. The trials confirmed the impression that perennial ryegrass is the most useful species for general purposes under local conditions on soils of medium to good fertility. It established itself quickly and has been consistently productive over the whole range of soils on which the trials have been sown. Successful swards have, however, been obtained in which either cocksfoot or timothy is dominant. At one centre, on a dry soil and under rather low conditions of fertility, a cocksfoot-dominant sward has been notably successful. At another, on heavy land, a satisfactory timothy-dominant sward has been obtained. Meadow fescue was included in the series of plots sown in **1941**, but there is no indication as yet that its inclusion has served any useful purpose whatever.

(b) STRAINS The stemmy commercial types under observation established themselves more quickly than the other strains and started growth somewhat earlier in the spring. The New Zealand strains were inclined to be stemmy and seeded early, but they covered the ground rather better and were more leafy than the commercial strains with which they were compared. The extreme leafy strains, such as S. **23** ryegrass, S. **143** cocksfoot and S. **50** timothy, have shown good qualities not apparent in the stemmy commercial and intermediate types :

(1) They can apparently tolerate without deterioration continuous hard grazing. At the other extreme, stemmy (Danish) cocksfoot has been almost completely killed out by this treatment and, at one centre in the Market Harborough district, a stemmy commercial type of ryegrass has fared little better.

(2) They cover the ground better and so tend to prevent the establishment of weed grasses and other weeds. In the S. **23** plot at a ryegrass trial laid down in **1941**, where the field before ploughing contained a large proportion of hassocks, there is now a much smaller proportion of tufts to be seen in the sward than on adjoining plots of commercial, S. **24** and S. **101**.

(3) They prevent over-development of white clover.

(4) There is no excessive peak of production, and thus the grazing is easier to control during the spring flush. It has been found difficult to prevent the stemmy commercial types from running to seed in early June.

S. **23** perennial ryegrass has been outstanding at all centres where a plot containing a preponderance of this strain was included. S. **50** timothy has been criticized as being too diminutive, but it has remarkable tillering qualities and produces a large amount of leaf ; under local conditions it has mingled well in the sward with ryegrass and appears to persist better than S. **48** or S. **51**.

S. **143** cocksfoot has shown similar attributes to those seen in S. **23** ryegrass and S. **50** timothy—that is, great tillering capacity and a dense production of leaf. S. **190** cocksfoot has been tried, and it is interesting locally in view of its having been bred from a Leicestershire pasture type. It is very leafy and mingles well with leafy ryegrass without any suggestion of tuftiness.

(c) GENERAL There has been a tendency in recent years towards extreme simplicity in seeds mixtures, not only of species but also

of strains within the species. In these trials it has been possible to compare the performance of extremely simple mixtures containing only one strain of a single species of grass with the behaviour of more complex mixtures including two, three or four species and up to four strains of each species.

Excellent swards have been obtained using S. 23 ryegrass as the only grass; excellent swards have also resulted where S. 143 cocksfoot and S. 50 timothy respectively have been the dominant grasses. The extreme pasture strains of these three grasses mingle well, and the most attractive swards have been those where S. 23 ryegrass has been dominant but where also S. 50 timothy and either S. 143 or S. 190 cocksfoot have been included.

Behaviour of Clovers In this series of trials both S. 123 and Montgomery red clover have persisted well into the third year, and some plants have survived into the fourth and fifth years. But there seems little point in including them in a grazing ley; anything which these red clovers do, S. 100 white clover does better, and from a much smaller seeding.

S. 100 white clover has been an outstanding success. It established itself quickly after sowing, and under local conditions it has developed a much bigger leaf on a longer stem than wild white, and there is much more stuff for cattle to bite at. It has persisted well into the fifth year and under grazing conditions there is no sign that it is disappearing.

Wild white clover has produced runners more profusely, and there are indications that it can compete rather more effectively than S. 100 with the extreme leafy strains of grasses. For short leys, however, up to five years, S. 100 appears to do all that is required.

New Pastures The improvement of grassland by ploughing and direct reseeding, and the laying of arable land down to leys, is now arousing much interest in Leicestershire, and several thousand acres have been so dealt with since the outbreak of war. Some doubt has been expressed as to the possibility of securing good takes and getting a quick establishment in our conditions of relatively low rainfall and moderately heavy soils. Some very difficult seasons have been encountered during the past five years. The normal rainfall in the county is between 24 and 30 inches, but in 1942 and 1943 it was little more than 20 inches in most districts, and the spring of 1944 was very dry. There have been very few failures, however, and experience suggests that provided the appropriate technique is followed, there is no greater reason to fear a failure of seeds in Leicestershire than of any other crop. The essential points appear to be:

(1) Preparation of a firm and fine seedbed.
(2) The correction of any soil deficiencies, particularly of phosphates and lime.
(3) The use of a suitable seeds mixture.
(4) Sowing early—preferably before the end of March.
(5) Drilling the seeds, especially on heavy soils.
(6) Stocking as soon as there is a bite on the land for stock to graze.
(7) Grazing throughout the early years of the life of the ley.
(8) Sowing without a nurse crop is preferable to sowing with a nurse crop, especially where weedy arable land is being laid down.

So far as the utility of the ley is concerned, with dairy stock there appears to be no doubt whatever in the minds of farmers that a good young ley is much more productive than most permanent grass. From the viewpoint of fattening cattle, however, some doubt exists in the minds of Leicestershire graziers as to the comparative merits of the young ley and the established fattening pasture. It is generally admitted that a

good young ley will carry as many, if not more, stock to the acre, but there is some uncertainty as to whether the young ley will produce the same degree of "finish" on cattle that the best old pastures are capable of doing. This is a problem which can be solved only by experience, and young leys which have been laid down in the Market Harborough district are being watched closely by local graziers. Evidence is accumulating that in the first and second years a good young ley can fatten bullocks to a high degree of finish and that a heavy stocking can be carried. In view of the great local importance of the matter, two large-scale experiments were laid down in the spring of 1944 to compare the merits of young leys with adjoining first-class fattening pastures on similar soils. Great interest is being taken in the progress of these experiments.

Leicestershire pastures have been justly famous. Many of them have been broken up to meet war-time needs—some with very natural reluctance on the part of their grazier occupiers. When the time comes for some of this land to go back to grass there is good reason to believe that the new pastures will be able to carry on the good reputation of their predecessors.

THE PRODUCTION AND USE OF SEED POTATOES

SUMMARY OF THE REPORT OF THE COMMITTEE SET UP BY THE AGRICULTURAL IMPROVEMENT COUNCILS FOR ENGLAND AND WALES AND FOR SCOTLAND

A JOINT committee of the Agricultural Improvement Councils for England and Wales and for Scotland was set up "to report upon the measures required to ensure that scientific knowledge in respect of the production and use of seed potatoes is fully applied in practice, and to make such further recommendations as to the growing and storage of potatoes as the Committee thinks desirable".

In its report the Committee emphasizes the high importance of potatoes as a rotational crop and as a national food. Before the war some 470,000 acres were grown annually in England and Wales, and approximately 135,000 acres in Scotland. Many growers obtain crops of 10 tons or more per acre, but the average national yield is slightly less than 7 tons. Even allowing for varietal and local factors which may depress yields, there is considerable room for improvement.

A large proportion of the crop in Scotland is grown primarily for seed, and normally provides 40 per cent. of the seed used in England and Wales. Seed production in England is of secondary importance in relation to the whole crop.

Breeding The Committee pays tribute to the valuable work done by private breeders and suggests that they should be given some assistance and encouragement. At the same time a comprehensive long-term policy should be instituted at the various Stations where scientific breeding is already in progress. Additional facilities will be needed here

also, for the aim should be the production of commercial varieties of high quality and resistant to pests and diseases. A full disease-testing service should be provided and combined with a registration scheme capable of preventing undesirable varieties passing into commerce.

Diseases and Pests The Committee recommends a greater study of the field-spread of virus diseases and the better dissemination of knowledge and advice on Potato Blight. The difficulties facing more widespread attempts to control Blight are appreciated, but it is suggested that the best approach would be on a regional basis supported by a local intelligence service. Demonstration experiments should be carried out over a period of years at several centres, and should cover the use of dusts as well as sprays and the trial of new haulm-killing agents.

The menace of eelworm is stressed. The insidious nature of attack is such that often the pest is not recognized by growers until it has already seriously affected good potato land. This and the risk of spread in many indirect ways compel the Committee to recommend some relief from the intensive cropping now demanded of certain areas. Compulsion to prevent too frequent cropping is considered justifiable, as also is administrative action to prevent the distribution of seed grown in infested soil—action which it is suggested could possibly be taken through the certification schemes at present in existence. It is recognized, however, that further investigation is required to provide a basis for more effective control measures.

Tuber diseases are considered to be of increasing importance, and to merit further research. The introduction of tuber inspection as a part of the certification schemes is recognized. Also the need for much stronger action to follow contraventions of existing Orders is emphasized.

Vegetative variations (bolters, wildings, etc.) should be more stringently excluded from crops certified for seed.

Departmental Certification Schemes The value and importance of the various departmental certification schemes is stressed by the Committee, and it looks forward to their full extension. Closer co-operation between the certifying departments is recommended, with the establishment of an inter-departmental committee to ensure uniformity and the pooling of knowledge.

The practice in England and Wales of restricting the highest grade certificates to approved associations is considered to have certain disadvantages. It is suggested that in areas suitable for maintaining stocks free from virus diseases, these certificates should be available for all crops attaining the prescribed standards of health, whether grown by a member of an association or not. Technical assistance should be readily available to all growers in such areas.

At the time the Committee held its meetings, it was considered that the nomenclature of certificates was confusing, and the "classification" required by the Seeds Act, 1920, misleading. "Class I (Scotch)" by no means implied that the seed was the best obtainable from Scotland, being merely the declaration required on a sale of Scotch seed, whether certified or not. Since the Committee presented its report, both the nomenclature of certificates and the classification have been revised and now meet the criticism of the Committee.

Though greater publicity is still desirable, the certification schemes have achieved much. Roguing is now common in many seed-producing areas, and often great trouble is taken to improve the health of stocks.

Maintenance of Health Individual efforts to maintain the health of stocks may be prejudiced by the presence of nearby crops seriously infected with virus diseases, and the Committee indicates that in certain circumstances it may be desirable to make it compulsory for growers to discard unhealthy stocks, or to prohibit the planting in the most suitable seed-producing areas of any seed below a certain standard. This is most necessary where small unsuitable areas, often near towns, occur in a district which otherwise offers exceptional facilities for isolation and hence for the production of healthy stock.

The spread of virus diseases in ware-growing areas is such that all steps should be taken to prolong the useful life of good quality seed. Measures tending to maintain the health of stocks are: (1) the planting of the highest grades of seed; (2) the growing of such seed at a distance from inferior stocks, or from sources of aphis infestation, such as fruit, vegetables and flowers; (3) roguing; (4) early lifting; and (5) haulm destruction. Little is known, however, of the relative importance of these measures in ware-growing districts, and more detailed investigations are required.

Though it is wasteful to send good seed into areas where deterioration is rapid, "zoning" of districts is not favoured. It is suggested that the end desired could be achieved by encouraging the use of certified English once-grown seed from the northern half of England in southern districts and for gardens and allotments.

In comparing the value of stocks built up from tested virus-free stocks with the best commercial stocks, the Committee considers that there is not yet sufficient information available to arrive at a reliable decision. Attention is drawn to the need for investigating the superiority in yield of such seed when grown under commercial conditions. It is considered that any scheme to provide continuous supplies of virus-free seed to the growers would necessitate such great changes in the existing systems of seed production and distribution that it would be justified only if the increased yields to be expected were substantial. The Committee wholeheartedly supports the efforts now being made by the National Institute of Agricultural Botany to produce nuclear stocks of virus-free seed, and suggests that the Scottish Department should consider similar action, so that such stocks may become available to growers of Stock Seed and through them pass to growers of "A" seed.

Methods of Cultivation Methods of cultivation are generally capable of improvement. The erection of chitting houses, possibly on a co-operative system, should be encouraged, and the possibilities of reducing costs of construction investigated.

Propagation from eyes has not yet reached a stage when it can be seriously considered for commercial adoption.

The advantages and disadvantages of "cutting" merit further investigation, particularly in the drier areas and on a farm scale.

Machinery Every encouragement should be given to the provision of improved machinery for planting, harvesting, riddling and grading. The use of rubber on spinners and riddles is recommended as a primary consideration as soon as the supply position permits. As a measure against the spread of eelworm, a brushing and cleaning device should be incorporated in grading machines to remove adherent soil.

Storage Greater publicity should, in the Committee's view, be given to the best methods of transport and storage, particularly with

a view to avoiding the chilling of seed. Investigation is required into methods of storing potatoes unavoidably lifted when wet or immature, and a more detailed comparison should be made between storage in clamps and buildings.

The Committee points to a danger in the pre-war practice of the Potato Marketing Board of raising the riddle to improve the sample of ware. Steps should be taken to see that the "small ware" riddled out is not stored for competition with certified seed.

Allotments Special reference is made to allotment and garden cultivation. The Committee favours the continuation of publicity stressing the importance of rotation, and although the danger of planting poor-quality seed is fully recognized, it is felt that the demand for "A" seed must not be encouraged to the point where commercial growers may be deprived of a sufficient supply.

Research and Experimental Work Many institutions of different types are at present engaged in investigation work. The Committee's report suggests certain additional subjects and new approaches, and arranges these in order of priority. The problems are, however, so interwoven that a greater degree of co-ordination is considered necessary, and it is suggested that the Agricultural Research Council should be invited to consider the setting up of a central committee for this purpose. The Committee further considers that conditions in Scotland offer particular advantages for research into problems of seed production, and also that Scotland has problems peculiar to its climate and husbandry.

To improve the transmission of existing knowledge to growers, the Committee emphasizes the value of a centre for England and Wales, and one for Scotland, where County Officers and others concerned could obtain information and submit problems about all aspects of potato-growing. At present they have to consult many scattered stations or search through a variety of publications. It is felt that the value of one centre to house specialist officers and to provide facilities for field work by research workers from other centres would be very great. It is recognized, however, that in England and Wales this suggestion is one for consideration in relation to the facilities likely to be made available by the National Advisory Service.

NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING

REPORT FOR YEAR ENDED AUGUST 31, 1944

IN the second annual report of the National Institute of Agricultural Engineering the main features of general development work are the same as were outlined last year,* namely, dung handling; mechanization of potato- and root-growing; silage-making; grain drying and storage; and the general problem of bringing tractors and their associated equipment more into line with small farm requirements. At the same time it has become evident that the actual work which can be done most usefully will depend on the particular problem and the way in which commercial development is proceeding. In some cases, the Institute is already concerned less with the "invention" of new machines than with working out mechanisms

* *Jour. Min. Agric.* **50**, 468.

for particular purposes, and with studying underlying principles. For example, no attempt is being made at present to evolve complete harvesters for either roots or potatoes, although experimental mechanisms for such problems as disposing of potato haulm, collecting sugar-beet tops, separating potatoes from stones, and so on, are being worked out. If and when any such mechanisms are perfected it will be for manufacturers to embody them in complete machines if they so desire. In other cases the most effective work is done by what may be called development testing: a continuous process of testing under known conditions; making constructive suggestions for modification and improvement; and testing again. Indeed, the importance of considered impartial testing as an essential aspect of development work, which only a fully-equipped Institute can undertake, can hardly be over-emphasized. Most of the testing work reported last year had been done at the request of either the Ministry or the Agricultural Machinery Development Board; and the hope was expressed that more would arise in the future from the requests of manufacturers themselves. This year over a quarter of all testing activities has arisen in this way.

Another essential aspect of development work is the collection and collation of general information necessary to give an accurate picture of the practical farm requirements which new machines must meet. The scheme outlined at the end of last year's Report for establishing a close liaison with representative groups of ordinary farms has now taken concrete form in a Farm Mechanization Enquiry. This will provide a practical background to the Institute's work, and will supply much of the detailed information which the industry requires. A noteworthy feature of the past year has been the number of manufacturers who have found it worth while to go to Askham Bryan for consultations about the types of equipment which farmers need; the general lines which design should follow; and the innumerable points which distinguish a good implement from a bad one.

The following are among the subjects which are discussed in greater detail in the Report: *

Dung Handling Work on dung handling has consisted mainly of extensive tests of appliances in course of commercial development. In every case the tests have suggested modifications which have been carried out; and, in one case—the Thwaites elevator and fork—five successive prototypes have been tried. Other appliances tested include a portable crane with self-acting grab; a buck-rake appliance built on to a wheel tractor; and a rotary loader. Because of the headroom required, the crane is suitable only for working in open yards or from field heaps; buck-rakes and similar devices fitted to wheel tractors are impossible to manoeuvre in average dung-yard conditions.

Tests of loaders were carried out in conjunction both with ordinary farm trailers and American-type spreaders. A British-made prototype spreader has also been tried and modified.

Sugar Beet Mechanization: SEGMENTED SEED AND THE REDUCTION OF SINGLING LABOUR After preliminary experimental work, the American-type shearing machine constructed last year was used to produce a quantity of seed for field trials at Askham Bryan and three outside centres. Although the results have not yet been fully worked out, it is clear that the use of segmented seed considerably reduced singling labour. Further work on seeding

* The full Report can be obtained from the Director, National Institute of Agricultural Engineering, Askham Bryan, York, price 3d. post free.

mechanisms will, however, be necessary before the drastic cross-blocking advocated by the Americans can be carried out and the full benefits of segmented seed obtained.

HARVESTING MACHINERY The most interesting development with harvesting machinery is the use of elevator potato diggers, fitted with special shares, for beet lifting. The Institute has worked out an experimental arrangement whereby a modified Catchpole topping unit, with power-driven, spring-loaded topping discs, is mounted direct to a tractor, which also pulls a modified elevator digger. Thus the elevator lifts the rows of beet topped on the previous bout, and delivers them in fairly orderly rows. The Institute is now working on some simple means of clearing the tops out of the way between topper and digger ; and if this can be done, the farmer, with a comparatively small additional outlay, will be able to use one appliance for two major operations. The modifications to the standard Catchpole topping unit were originally devised to make the Catchpole harvester less vulnerable on stony land, and, during a brief trial in Scotland, proved successful.

Detailed observations of privately owned Catchpole harvesters in Shropshire and Scotland are also reported, as well as work carried out and in progress in connexion with the cleaning of sugar beet.

Potato Mechanization : PLANTING Work on this subject has consisted mainly of a study of some of the crop husbandry problems affecting the design of potato planters. These include a comparative trial of dung applied in the baulks and dung ploughed in prior to planting ; observations on the effects of uniformity of seed and evenness of spacing ; and of planting in furrows down which various types of trailer and tractor wheels have run. No satisfactory automatic planter is yet available, the greatest obstacle to the development of such a machine being lack of uniformity in size of seed.

HARVESTING It was intended to carry out development tests of at least four prototype harvesters, but, due to the non-arrival of most of the machines until winter weather had set in, this proved impossible. Short comparative tests were made both at Askham Bryan and in Scotland between elevator diggers, spinners, and tractor-drawn potato ploughs. These tests showed that the elevator digger was the most effective type, but that there was little to choose between the other two.

Silage Handling One of the main reasons for the failure of ensilage to become more widely adopted is the amount of hand labour required. Last season's technique studies indicated that the man-hours per ton of silage produced are at a minimum when the capacity of the chopping and silo-filling machinery is equal to that of a wide-cut tractor mower, and when motor trucks are used for transport. Work at this level, however, requires equipment and organization beyond the reach of all except large-scale farmers and contractors. This year, the main objective has been to classify types and sizes of silage machinery according to the amount produced annually, and to explore the lower limits of mechanical handling. Observations on cutter-blowers indicated that a throughput of 30 cwt. per hour is about the minimum economic capacity for any farm. The medium-sized American cutter-blower, with a throughput of 3 to 4 tons an hour and a power requirement of about 20 h.p., was found to be superior to most British models. Observations in the field showed that the theoretical rate at which green material should arrive at the silo was at least twice that at which it arrived in practice, even on well-managed

farms. The usual procedure is to make silage in the early hours before haymaking or corn harvesting can start, and work often stops again before the organization gets into full swing.

Grain Harvesting, Drying and Storage Observations of most types of combine were continued this year, with special reference to the nature and amount of grain losses, the harvesting of laid and difficult crops, and the special features of design affecting these points.

As regards grain drying, the main object of study has been equipment for the small farm. An experimental installation at the Institute consists of a simple ventilated bin used in conjunction with a small drier (10 cwt. per hour under standard conditions). A pneumatic elevator designed by the Institute earlier in the year is used to carry grain from the receiving hopper to the ventilated bin, from the bin to the drier, and, when necessary, to blow a stream of cold air through the bin. This elevator needs only 3 h.p. to convey 40–45 cwt. of grain per hour through a distance of 60 ft., including a rise of 20 ft. The bin holds a full day's output, and with ventilation at intervals, not only prevents damp grain from heating, but also removes an appreciable amount of moisture.

The Institute has also developed a simple flowmeter which will indicate at a glance the rate at which grain is coming from a drier or bagging chute.

Farm Mechanization Enquiry Of the twelve centres originally contemplated, six have so far come into operation. About half the farms are less than 200 acres, and the remainder covers a wide range up to 1,000 acres. Some of them are highly mechanized; others still depend very largely on horses.

With the willing co-operation of the farmers concerned, a Recorder, stationed permanently at each centre, sends in weekly records of the daily work done by every tractor and horse, with particulars of the implements used and acreage covered. The general idea of the routine side of the Enquiry is to get accurate information about the way in which machines are actually used on a representative range of farms; about the main labour and operational peaks that occur; and about the influence on everyday working of any new machine or methods that may be introduced. In addition, by special inquiries made through Recorders, information is collected from time to time about the practical circumstances affecting particular problems on which other sections of the Institute are working—e.g., methods of dung handling on the farms concerned, the utility of 3-wheel tractors, methods of sowing grass seeds, and of lifting potatoes, and about types of implement.

The Report also describes the work done in connexion with Testing and Education. Over seventy County Machinery Instructors trained by the Institute are at work throughout the country and are being kept regularly supplied with educational material, including instructional films, leaflets and demonstration equipment.

GREEN PASTURES

V. GRASS PRESERVATION

W. A. Stewart with Clyde Higgs of Hatton Rock, Warwickshire, and Dr. S. J. Watson of Jealotts Hill, Bracknell, Berkshire (B.B.C. Home Service, November 30, 1944)

THE discussion opened with a reference to antiquity—whether, in fact, silage or hay is the older. The ancient Egyptians knew how to make silage, and Middlesex, a century or so ago, was renowned for the quality of the hay it supplied to the London stables. Mr. Stewart said that the objective then was green hay with all the leaf intact. Using a scythe, one man would mow an acre a day and five haymakers would follow, shaking up the cut grass to sun and wind, cocking and spreading out again several times over, making first small, then medium, and finally large cocks before carting to the stack. All the work was done by hand-rakes and forks.

Quality Hay In reply to a question as to what changes and losses occur in the process, Dr. Watson said that grass is still alive after it is cut, and during respiration uses up some valuable food material. If handled roughly leaf may be knocked off, and if badly made or stacked too soon hay will ferment, causing further loss of nutrients and digestibility.

"Then why are some farmers so fond of well-heated hay ? " asked Mr. Higgs. "I really don't know," Dr. Watson replied. "The loss even under fairly good weather conditions may reach 30 to 50 per cent. of feeding value." He went on to say that if farmers started cutting earlier and took more forethought, losses might be reduced 10 or 15 per cent. It is impossible for a farmer to get all his hay at the optimum time, but he should aim at getting as much as possible before the full flowering stage. Mr. Higgs started his haymaking too late this year, and had much of it ruined in consequence ; thereupon he resolved to mend his ways and, in future, cut for digestibility rather than bulk.

Mr. Stewart then inquired how best to preserve both leaf and green colour without undue labour. He has used tripods and then baled from the hay cock. Mr. Higgs has been ready with tripods every year, but with haymaking weather, got on with the simplest and quickest mechanical means.

Dr. Watson had a good word to say for the tramped cock favoured in the North, and on the question of colour advised Mr. Higgs not to bother about carotene, since kale would take care of that ; the important thing about hay is to preserve the *protein*. The average protein content is only about 8 per cent. ; it may be 11 per cent. where tripods are used. A late dressing of nitrogen pushes up the protein in hay.

Mr. Stewart's next question was how to preserve the quality of hay and at the same time use modern labour-saving methods. He suggested that the practice of cutting whole fields at a time and leaving the crop to bake or bleach in the swath until considered dry enough to sweep up to the stack is surely not the best that could be devised. Mr. Higgs agreed that the swath had got to be turned and the leaf preserved at the same time. A French machine which he once had used to do the job well. He thought that swath turners were never used slowly enough. At this point Dr. Watson put in a word for the side-delivery rake, but deprecated the use of hay loaders as being apt to cause loss of leaf. All agreed that grass needs to be turned very soon after cutting and that a turner might even

be affixed to the mower. (*Hay loaders save hand labour where hay has to be carted instead of swept, but does not their use in wet regions necessitate leaving the hay too long exposed to the weather ?*—Editor.)

Sweet Silage "If we can make hay with 11 per cent. protein . . . why bother with silage ?" was the next question. Because, according to Mr. Higgs, there is no competition between the two ; they are complementary. Ensilage is a flexible method of storing surplus grass in a time of plenty. Dr. Watson agreed. "Silage," he said, "should never be made at a time which is best for haymaking, but much earlier and much later"—with young grass at both seasons. Asked why ensilage, although practised in the last century, went almost entirely out of fashion, Dr. Watson explained that it was because it was looked upon as an alternative to haymaking and carried out with grass which was too mature. Such grass undergoes a high temperature fermentation, with consequent large loss of feeding value. Some air has to get into the mass, but not too much ; and acidity must be fairly quickly achieved. Hence the use of molasses and the attainment of a sweet-smelling product.

Mr. Higgs clinched matters. "All a farmer, like myself, has to do nowadays," he said, "is to aim at a temperature of 120°F. If it's too hot fill the pit more quickly ; if too cold, slack off a bit. I've got to add molasses and there I am."

Referring to portable silos, Mr. Stewart said that the bottom portion often stinks of butyric acid, the middle portion may be quite good, and towards the top there is a layer of overheated stuff. That is because the small silo is not used as intended, explained Dr. Watson. The small silo was developed for the small farmer with about 15 cows, requiring 30 or 40 tons of silage for his winter feeding. The farmer would cut ½–1 acre and put it in his silo between milkings. This means slow filling—anything up to 20 days to complete—but that is the way to make the best silage. If filled in about a couple of days the bottom is packed too tightly and does not heat up, and the top is not packed enough. The result is inequality throughout.

Operating in a big way, Mr. Higgs has found the answer to the problem by making pits 15 yd. long, 5 yd. wide and 1 yd. deep, holding about 100 tons. Such a pit can be dug in a day with a tractor scoop. Trailers are brought over the top and the crop is carefully spread. (*Evidently he has given up the gadget of pulling off the load with ropes*—Editor.)

As regards machinery, Mr. Higgs uses a cutlift with a tractor and trailer in the field, and another tractor and trailer hauling to the pit. He is not altogether sure that even a small man cannot afford a cutlift. Dr. Watson thought an adaptable hay loader would be more in the ordinary man's line. That some kind of labour saving device is needed seemed to Mr. Stewart to be indicated by the fact that during the past two or three years there has been a decline in silage-making. This, Dr. Watson said, is because the small man has discovered that protein can be obtained more easily by coupon and from oats than by picking up his own grass. Nevertheless on the west side of Britain small farmers should have continued to make silage. They would get two or three times more feeding value from grass than from an acre of oats, particularly where they cannot harvest the corn.

Grass Drying In Mr. Higgs's view grass-drying is not yet a commercial proposition for the farmer providing food for his own cows. Ninety tons might supply the needs of a 30-cow dairy, and with

a throughput of 4 or 5 cwt. an hour, it would take about a month's continuous work in spring to get it. He did not agree with Dr. Watson that grass of as high protein content could be obtained also in autumn. When there is a grass drier available costing £250 which will turn out about ½ ton an hour with two men, he will go back into grass-drying. Dr. Watson agreed that while theoretically grass-drying was the most efficient means of conservation, the size of the machine is the limiting factor if it is to be related to the farm. Selling dried grass is a different matter.

Mr. Stewart expressed some qualms about the effect on fertility of taking several cuts in succession even when fertilizers were given, but seemed reassured when Dr. Watson counselled cutting not more frequently than one year in three. As for drying grass from aerodromes, Mr. Higgs did not think that cows and planes liked the same sort of grass, and that was that!

Closing the discussion Mr. Stewart said that good quality hay is still the best basis for winter feeding. Earlier cutting and cutting smaller areas at a time is to be recommended. Ensilage is a supplementary way of providing winter keep, and succulent keep at that. Grass-drying presents an engineering problem involving greater throughput at less cost. "In the meanwhile let's try to make the grass from our green pastures into better quality hay and silage."

VI. GRAZING

W. A. Stewart with H. H. Pickering, O.B.E., of Waterloo Farm, Market Harborough, and Will Hogg of Earlston, Berwickshire. (B.B.C. Home Service, 14th December, 1944)

THERE are certain fundamental differences, said Mr. Stewart, between the pastoral practice of Leicestershire and that of another well-known grazing district—the Borders. In Leicestershire the pastures are permanently old, and their growth throughout the summer is controlled by varying the numbers of stock. In the Borders the pastures have for many years been of the temporary, rotational kind, and they carry a fixed stock throughout the season.

Differences in Grazing Technique

Mr. Pickering, speaking for Leicestershire, said the graziers' aim is to maintain the quality of their grassland, and to do this they must avoid overgrazing in the early weeks of the season and prevent over-growth in the full flush. They keep their pastures grazed evenly all the time. Mr. Hoggs—from the Borders—is less concerned about spoiling the quality of the grass. They grow grass, he said, for the sake of their cattle and sheep, not the other way about; and if the grazing is not always as close as it should be, the mowing machine is put in to top it off.

Such vandalism (!) seemed to shock Mr. Pickering. "Our Midland pastures," he stated, "are what they are because of our habit of stocking. That is why our grasses are the foundation of many of the new pedigree strains." Asked for an estimate of the number of bullocks required to stock such land, he said the grazier must be prepared to put on up to a beast-and-a-half to the acre. To be able to add or withdraw beasts in accordance with the season requires a reserve of moderate land. For 160 acres of top-grade feeding land rather more than 200 acres of additional grass are needed, and such practice, he said, was fairly typical of the Welland Valley.

"It does seem clear then," commented Mr. Stewart, "that some other land has to be abused by over- or under-stocking in order to preserve these famous fattening pastures." Mr. Hogg, however, thought it is fundamental to any sort of long-term grass farming to handle part of the land in such a way that another part may be kept in high condition. He regards his

rough hill grazings and some of his permanent pasture as a very necessary adjunct to ley farming. Summer over-growth is invaluable in winter and spring, when cattle, if given some roots, will clear off the roughage and thrive well pending the stocking of the good grass. "You should avoid stocking leys too early if the land is wet," he added. Mr. Hogg then put this point to Mr. Pickering: isn't the manner in which good permanent pasture is left in the winter more important than summer management?

Mr. Pickering was inclined to agree: the pasture must be evenly grazed, so that there is no roughage at the end of the season. The ewe flock sees to that. All agreed that a pasture cannot be grazed properly unless there are sheep as well as cattle.

Continuing, Mr. Pickering gave details of his technique—removal of all horned stock by the end of November, picking up and "knocking" of manure clots and chain-harrowing. Before the war it was customary to have a man continually employed shovelling up the clots and removing them from the field. Neither Mr. Stewart nor Mr. Hogg thought they could attain this refinement, although they would use chain harrows. With some hesitation in Mr. Pickering's presence, Mr. Hogg again suggested the cutting of patches that become coarse where animals lie. Incidentally, last year, he had to top a 19-acre field of third-year grass, which was carrying 29 cattle, 31 ewes and 66 lambs. Mr. Pickering insisted that clot spreading is not a waste of time. The stocking in Leicestershire is heavy, and before the war the cattle were given cake; every fourth or fifth year the pastures were dressed with 6 cwt. of basic slag per acre.

The Question of Productivity Mr. Hogg thought that in the North, where they use the plough, they can afford to be less meticulous than in the Midlands where, he assumed, it would be impossible to renew the kind of pasture Mr. Pickering is farming.

"But is it impossible?" questioned Mr. Stewart. "A lot of people think that Pickering and his neighbours are carrying out a lot of expensive ritual and getting comparatively little in return from very high-class land." In reply to a question as to what his experience of ley farming has been, Mr. Pickering said it is, as yet, too early to pronounce definitely, but he has already seen one difference—with a new ley there is nothing like the same certainty; it cuts up badly in wet weather and gives up growth sooner in drought; it is more of a gamble.

What did Mr. Hogg think? "Well," replied Mr. Hogg, "in spite of the fact that I've had 25 years' experience of ley farming, I would agree with Mr. Pickering that a really good old pasture should be treated with respect, and I would certainly hesitate about ploughing it up." He added that in his part old pastures were equal to the best leys for quality. In September and October the old pasture was the more dependable.

Mr. Stewart then reminded Mr. Hogg that the Borders were originally a sheep country which, by ley farming, had developed a beef industry. Was it not possible that if the bullock-grazing land in Leicestershire were converted to ley farming the number both of cattle and sheep might be increased?

Mr. Pickering replied to this question by asking another: "Do you yourself think that when we've ploughed up our best pastures we are going to put them back to anything better than they are?" Their productive capacity, he added, was 3 to 4 cwt. of beef (live weight) and 40 to 50lb. of mutton (dead weight). Mr. Hogg's corresponding figures for the Borders were 3 lambs of at least 80 lb. (live) and 2 to 3 cwt. of beef (live), which seemed to him a sound argument for ley farming, provided grain or potatoes did something towards the additional labour costs.

Mr. Pickering admitted that by growing food for direct human con-

sumption he could achieve a greater output per acre, but, he inquired, would even bumper wheat crops be able to compete with world prices after the war? "I think when people talk about balanced farming they're too apt to regard 'balance' as applying to the individual farming unit. I should say that we want balance over the country as a whole. You can grow potatoes in the Fens, sugar beet in East Anglia, and let *us* specialize in grazing."

Hereupon Mr. Hogg surmised that the real problem in the Midland grazing districts was the dearth of buildings and cottages. For that, he would suggest mixed farming: it was a safeguard against a glutted autumn market. Mr. Pickering agreed, but said it would be an enormous programme to put up the necessary buildings and cottages; it would require a settled policy, not just for four years, but for forty at least. Mr. Hogg shared the same view about the need for a forty years policy "because in spite of having buildings—and good buildings—north-east Northumberland before the war was almost entirely grass." Before leaving this subject Mr. Pickering conceded that he was something of a mixed farmer himself and proposes to retain, with the help of tractors, one-quarter of his three- or four-horse land under the plough after the war.

Controlling Grazing The next question concerned electric fencing: would it, for example, make for easier management of Mr. Pickering's 70-acre field? Mr. Pickering and Mr. Hogg thought not; bullocks, and sheep also, like a good range. Dairy stock seem to be different in this respect, remarked Mr. Stewart, and the electric fence was handy for shutting off portions for silage. Mr. Hogg agreed that the ley farmer must be prepared to make hay or silage when growth gets the better of him. In this way clover can be controlled—too much of it does not suit cattle in wet weather.

On this point Mr. Stewart indicated that clover has been responsible for a lot of cattle becoming "blown" or "hoven". It is not a complete solution to winter the cattle well, to introduce them gradually to the young grass, give them access to straw, and so on. He thought that one of the reasons why Midland graziers prefer old bullocks is that they are less liable than younger cattle to blow and scour. Mr. Pickering concurred but added that in a congenial summer—one not too wet—younger beasts would do quite well.

Shelter and Water Mr. Pickering was very definitely of opinion that cattle need shelter in summer just as much as those which are out in winter. The older graziers used to build a sizeable hovel in each field. Shelter stops "gadding," as well as giving protection from sun and wind. In Mr. Hogg's country there are plantations. He is quite sure that without adequate shelter belts and buildings to give shade and protection, ley farming cannot successfully be extended.

Water is equally important, rejoined Mr. Pickering. He finds that when cattle are taken off a field that needs a rest and put on moderate pasture with a good water supply, they will not shrink; if there is a bad water supply they will not graze at all. Water is all the better for a little warming, as in a reservoir: he is not fond of cold spring water. Mr. Hogg was rather surprised at this. "We in Scotland," he said, "regard a good burn as our finest water supply." (*But wouldn't burn water generally be warmer than spring water?*—Editor).

Mr. Stewart was not sure about some of our brooks; he thought that many of them are foul and a menace to anyone wishing to maintain a disease-free herd. Summing up, he made it fairly clear that his attitude to permanent pasture was like that of Mr. Coolidge's preacher to sin: he was against it.

SKILLED HERDSMEN OBTAIN MORE MILK

AVRIL D. CADDEY

Egham, Surrey

THE demand for more milk is still insistent, and this can most quickly be met by an increased production per cow. Most dairy farmers can respond to this as is amply shown by the high average obtained by the leading herds of the dairy breeds in the Milk Recording Scheme. For the most part these high yielding cows are not greatly superior in their breeding; neither does the owner feed them some secret food. It is just that the owner or his herdsman happens to be highly skilled—and of all farm work milk production calls for keen and skilled men. I can think of many examples where high yields in several different dairy breeds have accompanied a cowman from one herd to another. He achieves his success purely by skill and devotion to his herd, and by giving particular attention to individual animals.

The Cowman makes all the Difference My own experience is enlightening. Amongst the first Jerseys I had, the highest yielding cow gave 570 gallons in the year. The following year, with a different cowman, the same cow on similar food gave 900 gallons. A friend of mine has just had a parallel experience: last year his herd yield was low, but with a change of cowman the same cows are now averaging 1,000 gallons each.

For a while I had a man who was the best milker I have ever seen. He was expert in obtaining high yields, and promptly set about making a cow whose highest yield previously was 1,000 gallons into the E.J.C. Society's Register of Merit champion for both milk and butter-fat (15,162 lb. milk and 789 lb. butter-fat; her highest daily yield was 74½ lb.). Unfortunately he left before her lactation was completed, otherwise I am sure her record would have been even higher. Another man we had on the Friesian herd expected, and often obtained, yields up to 10 gallons per day—and that on war-time feeding. Both men made a study of the cows under their charge, and took every care to ensure that they were comfortable; for milk is made while the cows are lying down and chewing the cud.

Perhaps the most striking example of all is seen at open milking trials at the Royal and London Dairy Shows. It may be contended that the cow that won the open milking trials at the Royal Show for five consecutive years was an exceptional animal; she may have been, but many cows are bred on similar lines. I would say rather that her owner has an exceptional herdsman, particularly since he won other open trials with different cows.

As much as progressive breeders like to prove their herd sires by the records of their daughters, the results are often not entirely satisfactory because the daughters have not had the same attention as their dams, or feeding in war time is too restricted for a maximum output. Allowance must be made for these factors. To keep herself, produce a calf, and yield a large quantity of milk, a cow must be given sufficient food to satisfy all her requirements, and yet not have too much; moreover, she must be fed regularly and frequently.

Promoting Herd Efficiency The general level of herd efficiency could be raised by arranging more milking classes and competitions in every county, whereby men could be trained to become first-class milkers in the widest sense of the term—clean, quick

and thorough. I hear that Surrey is reviving the milking competitions which were such a great help a few years ago; other counties would do well to follow suit. I think also that there should be more Farm Institutes, with a high yield expert and a high yielding herd at each, and greater encouragement given for the attendance there of promising young herdsmen. Some people, no doubt, have a natural tendency to make a success of their job, but if the will to learn is there the knowledge can frequently be gained by experience and stimulated by competition.

THE OESTROSCOPE

A SIMPLE DEVICE FOR TESTING FOR OESTRUS IN COWS

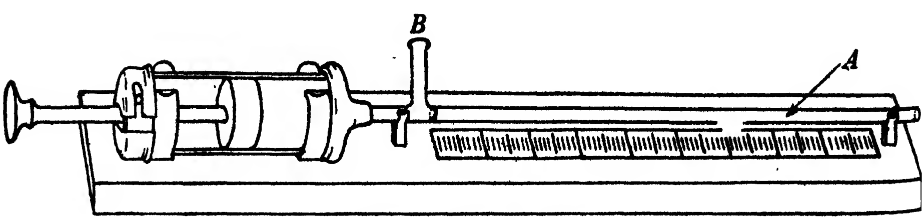
G. W. Scott Blair, M.A., D.Sc., F.R.I.C.

National Institute for Research in Dairying, Shinfield, Reading

MUCH valuable time is sometimes wasted in getting cows and heifers in calf because of failure to recognize the symptoms of heat, especially in the winter months. It has long been known* that the mucous secretion from the cervix which comes down into the vagina and is sometimes even to be seen hanging from the vulva, is not only much more plentiful in season but has a peculiar kind of elasticity at this time.

Scott Blair, Folley, Malpress and Coppen†‡ have made use of this property in the design of a simple instrument called an oestroscope, which consists of a narrow glass tube (A) with a small side tube (B) near one end, which is joined to a hypodermic syringe.

The mucus, which is carefully taken by hand from the upper vagina, is roughly mixed by squeezing between two glass plates, and a little is sucked, by means of the hypodermic into the tube (A) so as to fill it, the tube (B) being kept closed with the thumb. The excess is removed from the end of (A), so that a column 10 cm. long (as shown on the scale) is left in the tube, which is then laid down flat.



(Copyright: *Biochemical Journal.*)

* Hammond, J. (1927) "Reproduction in the Cow." Camb. Univ. Press.

† Scott Blair, G. W.; Folley, S. J.; Malpress, F. H.; and Coppen, F. M. V., *Biochem. J.* (1941) 35, 1039.

‡ Scott Blair, G. W., et, al. *Vet. Record.* Nov. 29, 1941.

The mucus is then slowly pushed out of the tube by means of the syringe, keeping (B) closed with the thumb, until the end of the column reaches the point marked 7 cm. on the scale, the 3 cm. of mucus so displaced forming a blob which hangs freely at the end of the tube. At this point, the thumb is released from (B), and if the animal is in season the mucus will flow back so as to refill or nearly to refill the tube. If she is not in season the amount of recoil is small or negligible (not more than ½ cm.) unless she is just coming in or out of season, when a partial recoil will take place. It is not possible to tell from a single test whether oestrus is just past or not yet fully reached, and in such cases the test should be repeated an hour or two later.

The test is done very simply (it is easily carried out in the cowshed) and takes less than two minutes to complete, but since care is needed in taking samples from the vagina of the cow, especially in young animals, it is suggested that those anxious to use the method should first discuss the matter with their veterinary practitioner. The method has now been used continuously for four years and is completely reliable.

THE MAINTENANCE AND IMPROVEMENT OF THORN HEDGES

ALBERT SMITH

Stapenhill, Burton-on-Trent, Staffs

THERE is a real danger that under modern farming practice the hedgerows of the British countryside will soon disappear, and in their place we shall have only wire and electric fences, which give no shelter to stock or sanctuary to birds. It is pleasant to see the hedges neatly trimmed, but the brushing of hedges must not continue year after year until there is only old, brittle thorn left. As soon as a hedge shows signs of getting thin in the bottom, the annual brushing should cease in order to allow sufficient thorn to grow so that the hedge can be cut and layered—a process which rejuvenates it and makes an effective barrier against all stock.

A hedge should be cut and layered only between the fall and the bud of the leaf; at this period the sap has withdrawn to the roots. When it rises again in the spring, strong, healthy growth from the new stools will be promoted.

Suitable tools are most important. They should consist of a 5-lb. axe (Kent pattern), a double-sided billhook, a strong slash-hook, and a pair of strong leather mittens to protect the hands. Although it is seldom necessary to use a saw, pieces of thorn are sometimes found which cannot be got at with either axe or hook without damaging other pieces required

for layering. On these occasions a saw is most useful. Axe, billhook and slash-hook must each have a thin, sharp edge; blunt edges will split the stools and do irreparable damage to the hedge.

Before cutting and layering, all briars and elder should be removed *by the roots*. Elder is particularly harmful to thorn, and if left in a hedge the thorn will die, leaving many gaps through which stock will tend to stray.

Dealing with a Hedge in Good Condition Assuming the hedge to be new or one which has been well cared for and now requires re-layering, it should be brushed on the ditch side to give access to it; but no more should be cut away than is necessary. All dead wood and rubbish which have accumulated in the hedge bottom should be removed.

If the hedge is on sloping ground commence at the highest end and lay upwards. After freeing the first thorn from its neighbours commence to lay the "pleach" (as the part to be layered is called) by making a clean cut, starting about 12–18 in. high and tapering down to ground level, where the pleach must be made to bend.

In cutting, be careful to note the required direction of the pleach and thus avoid twisting into position. Thin the pleach well down; the new growth is required from the stool, not along the pleach. As the pleach is lowered it should be laid away from the stools towards the stock side of the fence to allow unrestricted growth from the stools. Trim the lip off the stool by a clean upward cut in the direction of pleach, so that the stool and pleach make a continuous line.

After layering a few pleaches fix them in position by driving stakes, with their points directly behind the stools, at regular intervals of 2–3 ft., according to the length of the pleaches. Use only dead stakes. If the hedge is a good one plenty of surplus thorn will be found suitable for stakes, which should be cut to a length of about 5 ft. Never leave live stakes; a live stake makes a dense, bushy growth at the top, which smothers and kills surrounding stools, leaving the hedge open in the bottom. All straggling branches should be intertwined between the stakes, thus giving strength and stability to the fence.

Work along the fence taking each piece in turn, layering small thorns into the bottom to fence against sheep, and layering the heavier ones at an angle of about 45 degrees from the ground to put body into the fence to prevent cattle from straying.

After layering a hedge in this manner it will be found necessary to go along the brush side and intertwine any long pieces protruding on that side. Do not cut the brush back, as this would weaken the fence and leave spars on which the cattle can rub and damage the hedge. Any strong pieces protruding can, however, be cut off, but this must be done well back in the brush to hide the spar.

When the cutting and layering of the hedge has been completed the ditch should be dug out and the soil banked around the stools of the hedge, leaving about 2 inches of stool showing. Both sides of the ditch should slope towards the middle, and must be dug deep enough to clear all drains and thereby assist in draining the surrounding land. Light, clean thorns may then be placed in the ditch to prevent cattle from treading down the sides and eating the young growth from the stools. If there is no ditch to the fence a few thorns, with their thick ends uppermost, should be placed at an angle of 45 degrees over the stools, thick end wedged between

the pleaches. These precautions will protect the young growth from stock for about two years. Thereafter it will be strong enough to take care of itself.

Old Hedge requires Bottom Growth In many hedges old pleaches will be found which cannot be cut out without leaving a weak place. These must be lowered to the ground and well trimmed with the axe to encourage new growth from the stool. Old stumps will also be found which cannot be pleached without cracking off. The best method of dealing with these is to dig round the stumps, taking care not to damage roots and then to sever all roots, except those running at right angles to the fence. These will bend and allow the whole bush to be lowered into position. Any roots that are cut should have their tops exposed about 2 or 3 inches to encourage new growth.

After layering an old hedge all gaps should be planted with young thorns 1 ft. apart. Keep these in a direct line with the stools of the hedge, and tread the roots quite firm. Success can be achieved only by planting during late autumn and early winter.

A thorn fence dealt with in this manner will prove an effective barrier against all stock, and will provide plenty of material with which to work when next it requires layering.

WINTERING HILL SHEEP

CAPT. G. L. BENNETT EVANS

Llanidloes, Montgomeryshire

WANTED. good clean wintering for five score ewe hoggs October 1 *to April* 1. That is the kind of advertisement one sees in an agricultural or local paper in the autumn. Wintering on low-lying farms is getting scarce and much harder to come by than it was before the war, due mainly to the increased arable acreage.

Usually in September there is a fair where the business of taking wintering is transacted and hill flockmasters meet the lowland farmers to discuss terms. Wintering is generally looked for in a district near the sea, where snow does not lie for long, and the salt in the air and herbage acts as a tonic and corrects any mineral deficiency suffered by the hogg. Shepherds will tell you that the wintering to-day is not nearly as good as it used to be, owing to the introduction of wire fencing. Farms, they say, can now be divided into sheep-proof sections, and broken fences and ragged hedges are quickly and cheaply mended ; thus freedom is denied the hogg, who is confined and perhaps stays too long in the same field.

A Good Wintering Farm I was always taught when searching for a wintering farm to take particular notice of the following points : (1) the state of fences and hedges ; (2) aspect of the farm (south preferred) ; (3) foggage ; (4) drainage ; (5) kind of stock kept on the farm and number of horses ; (6) freshness and cleanliness of pastures from other sheep ; (7) brambles ; (8) the farmer's standing with his neighbours.

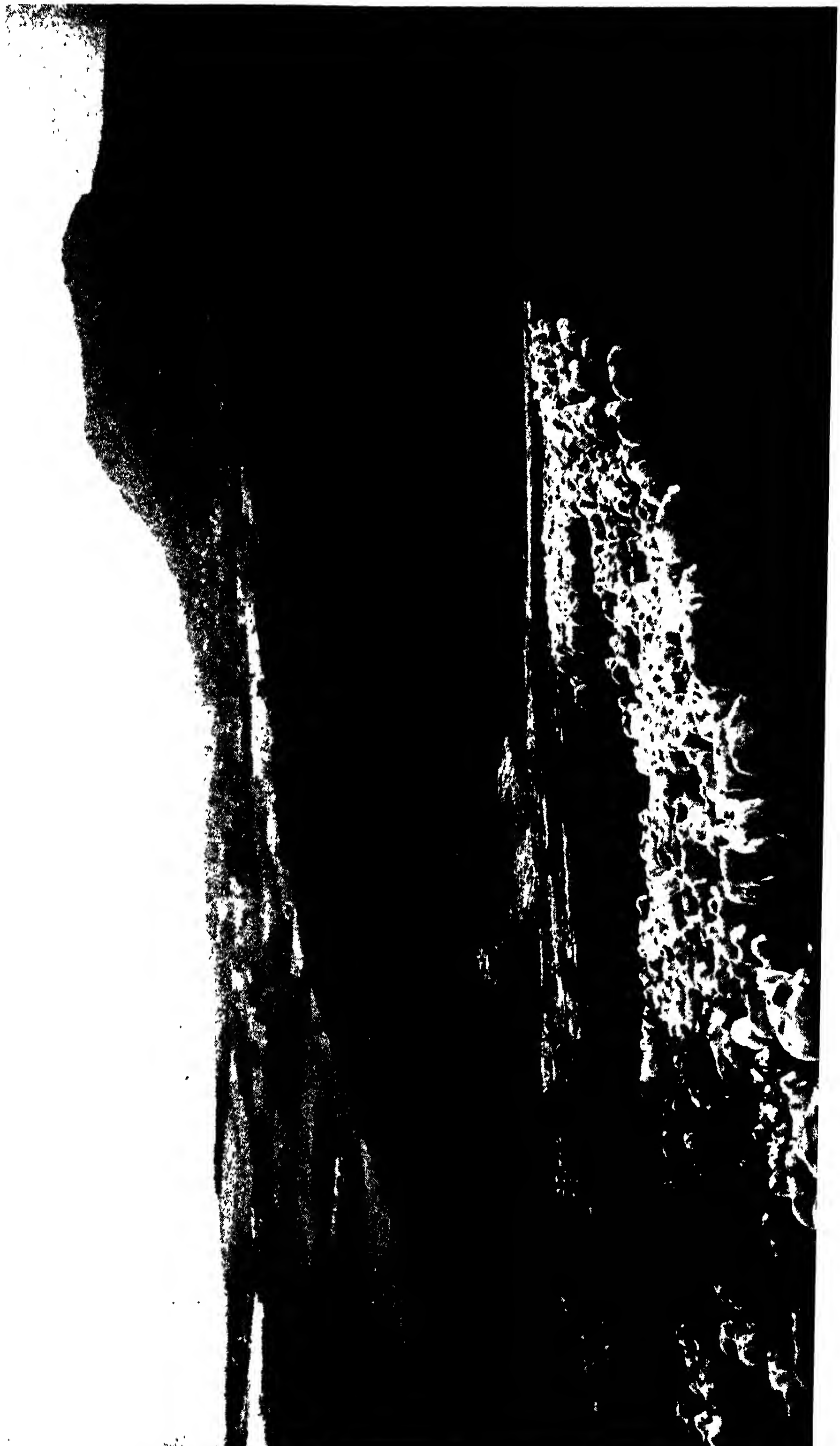
A "tack" farm facing South is preferable to one facing North or East, and a sloping farm is more desirable than one dead flat. The absence of rushes will tell you that there is good natural drainage, and this is vitally important if the hoggs are to avoid fluke and "rot". The value of a farm is discovered through experience, and the reputation of a "wintering" depends on its soundness or otherwise and the honesty of the "winterer". Once satisfaction is given, the "tack" farm may be linked to a certain hill flock for generations, so it is not easy for a newcomer to a district to get in on good, sound wintering.

Sometimes a farm selling off in the autumn offers good wintering until the expiration of a tenancy at Lady Day, but there is the risk of the hill being covered with snow on March 25 and a likelihood of heavy loss. In the ordinary way the period of wintering is from the first week in October to the first week in April. If the winterer happens to be a milk seller, his anxiety to be rid of all sheep early in the spring is all the greater.

Transit and Care Some flockmasters even to-day insist on walking their hoggs to "tack" instead of sending them by lorry. The reason given is that, by walking, the kidneys are well exercised, the animals urinating frequently and generally evacuating any poisons in the system. They are not, therefore, so likely to "strike" on the new farm. Inoculation and drenching against braxy and worms is now practised generally, and lorries are used for transport by the more modern flockmasters. The lambs are shorn if there is a danger of brambles, and as a precaution in the absence of good and regular shepherding.

The hoggs are usually visited by the owner round about Christmas and again in February. Losses in wintering vary, but a loss of 5 per cent. would be high in most years. The usual condition of payment only for those alive on return in April is the common rule, though some insist on payment for those alive on January 1. To prove death a skin or ear is usually produced. The price per head varies to-day from 10s. to 15s., as compared with 4s. to 5s. in 1914–18. The flockmaster who tries to save on wintering by keeping his lambs on the hill not only loses in numbers, but also in size, and particularly in the wool-sheet. Hoggs wintered hard lose most of their wool on the hill as soon as they start to mend.

More Culling is Needed So far mention has been made only of wintering away on low land; but, owing to the scarcity and costliness of suitable wintering, some effort is being made to accommodate some of the hoggs on in-bye land or "ffrydds" taken in from the hill. The business of "tacking" is made easier if the practice of keeping old wethers is eliminated and the wether lambs sold off. It is my experience that for some reason or other it is more difficult to keep wether lambs alive during their first winter than ewe lambs. With only ewe lambs to winter, care must be taken to cull the poor quality lambs, or "bottoms," and sell them off. There is, in my opinion, not enough culling done amongst hill flocks in order to maintain a higher standard of quality and hardiness. The latter, above all else, is a most desirable characteristic that must always be borne in mind, and to this end the culling must be drastic to eliminate the soft, slack animals; only those with hard, dense coats should be kept. When the "bottoms" have been sold off, the "mediums" are then marked for wintering away, and generally only the "tops" are kept for wintering at home.



[Photo: *Farmer and Stockbreeder*

WIREWORMS AND WAR-TIME FARMING (See pp. 462-8)

Fig. 1. One wireworm and five seeds to every 6-inches of drill row is equivalent to 300,000 wireworms per acre and 2½ bushels of wheat seed per acre.

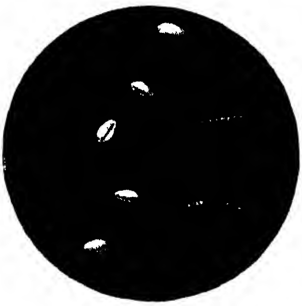


Fig. 2. Two wireworms and five seeds to every 6-inches of drill row is equivalent to 600,000 wireworms at the same seeding rate.

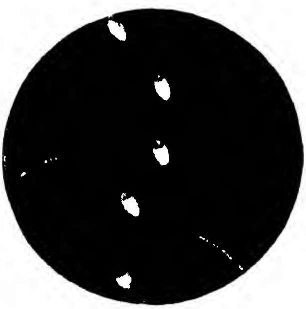


Fig. 3. Three wireworms to every 4½ seeds is equivalent to 1,000,000 wireworms per acre at the same seeding rate.

Fig. 4. Represents an increase of ½ bushel of seed per acre at the 600,000 wireworm population level shown in Fig. 2.

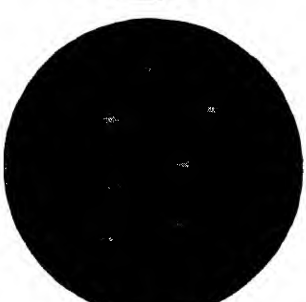


Fig. 5. Represents an increase of 2 bushels per acre over that in Fig. 3.

Photo: *Long Ashton Research Station, Bristol.*

Improved Pastures Nowadays on many hill farms, thanks to the internal combustion engine and mechanization, bits and pieces on the lower slopes of the hills are ploughed, limed, turniped and sown out with a seeds mixture containing wild white clover. This practice has given the hill farmer an improved pasture of a totally different kind from the old, matted herbage, and enables him to reserve these intakes either for wintering the ewe hoggs, or as keep for the lambing ewes. Fresh clean patches like these are most useful on a hill farm when ewes are found to be short of milk, and it is astonishing how the flow of milk is stimulated after even one day's grazing.

A note of warning should, I feel, be given at this point, though the experts will tell you to graze and keep down your improved pasture. This practice of baring pastures is, I think, dangerous, and may lead to heavy losses if a snowstorm catches you with little or no foggage, especially in the absence of a large store of hay at hand. So contrary to expressed opinion, my advice is never to bare your hill pastures, whether they be improved or otherwise.

The Importance of Foggage I mentioned "foggage" in my list of points to look for on a wintering farm. This I consider is equally important, perhaps more so, on the hill farm. The sheep must have something to scratch down to during snow, and sheep that do not know how to scratch for a living are condemned to starve. If there is nothing to be got after scratching through the snow, then the position is very serious and starvation faces the flock if the snow continues for any length of time. Snow remains longer on bare ground than on "foggy" land. It was a sad day when the hill wether became unfashionable as mutton and was taken off our hills. The old wether did an enormous amount of spade work for the ewe during her trials in a snowstorm, by cutting through drifts and scratching down to the foggage. Good fencing is necessary to reserve some foggage for the winter as a safeguard against frost and snow. Frost gets a better grip on bare pastures than on "foggy" ground.

Hay—But only as an Insurance The practice of feeding hay during the winter is quite common where the number of hoggs is of manageable size, and they do well on it ; but it makes them very dependent on the hay bag, and they lose their natural instinct to fend for themselves. Sheep soon learn to hang around gateways, looking through the fence awaiting the arrival of the hay. An old shepherd told me once : "I hate sheep who stand and look at me. I like sheep who, when they see me, turn, snort and run away." Hill shepherds dislike sheep that bleat and follow wherever they go, like Mary's lamb of old. In days when labour was cheap and plentiful the flockmaster used to send three or four men to cut bog hay, chiefly molinia, with scythes, and have good stacks of it made at convenient points on the hill. This was a splendid plan and an insurance against heavy losses during a hard winter. But even if the labour were now available, I doubt if the men would take kindly to the scythe under present conditions. A good method to-day is to place baled hay at the required places and use it only in an emergency.

Wintering at Home I believe that shortly more wintering at home will be practised in the light of modern progress, thus saving time and money and making the hill farm more self-sufficient. Wintered-away hoggs take more settling down and looking after on their

return in the spring, and there are always some who have good memories and a sense of direction, remembering their winter quarters for years. In foul weather on the hill they will strive to reach their old wintering, sometimes perhaps more than 20 miles away.

There is far less trouble with settling the home-wintered hoggs, though they remember the sweetness and palatability of the improved intakes and will make every endeavour to break through the fences to get there. Resort to "cousing" with the dog kept for that particular job of "sending away" is the only hope of keeping them out, and the shepherd, for those important weeks, must rise early and make frequent visits during the whole day. This "keeping the sheep up" is usually connected with peat cutting, when an eye can be kept on the sheep during spells from this back-breaking work.

On Return Before the days of fences, when the hoggs returned from wintering, the flockmaster and his staff used to make the required number of collars of twisted moss, known as Polytrichum or in Welsh, *sidan-y-waun*. These were put round the sheeps' necks with the front leg tied up, before the sheep were taken to their heft. This prevented their straying, and in time they tended to forget their wintering places. If the weather turned soft and dewy, with the wind in the South-west, this form of discomfort could be discontinued after a week or 10 days, but if there were a keen easterly wind a careful watch by the shepherd was more than ever necessary to keep the returned winterers from breaking away over the boundary.

Better Pasture on the Hills The new technique of hill improvement is rapidly extending, and it is to be hoped that Hill Research Stations will be set up to further the good work. The question of nutritional deficiencies is ever present, and shortage of minerals on the hills is, I am sure, one of the causes of under-nourishment and disease. To remedy this I feel that something should be done to change the chemical content of the indigenous native grasses by application of lime and phosphate. Hill Research Stations could tackle these conundrums and perhaps explore how the aeroplane might be used to distribute the required lime and phosphate. This would undoubtedly be a great step forward, and would go a long way towards making our hills the home of hardy sheep and virile men.

For the 6,000,000 acres of rough grazing in England and Wales, my formula would be: sheep and cattle and lime and phosphate. The result in five years from the date of application would be a greatly increased head of live stock in our agricultural returns.

WIREWORMS AND WAR-TIME FARMING

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AT the outbreak of war most farmers and many agricultural advisers regarded wireworms as a serious menace to successful crop production on ploughed-up grassland. It was well known that wireworms were likely to occur whenever grassland was broken for arable cultivation, and that their attacks might continue for two or three years. In observed cases attack by wireworms had appeared worse on the second crop after breaking than on the first, and thus it seemed likely that on much of the

grassland to be ploughed for war-time production wireworm attack might jeopardize the success of the crops for some time. Many of the men who farmed in the 1914–18 period recalled that widespread crop failure had been associated with wireworms. Failed patches were common in many newly broken fields, particularly on thin soils, and wireworms were found in numbers in such patches. Crop production on newly broken grassland was regarded by many as something of a speculation, and ploughing on the vast scale demanded by the Minister of Agriculture seemed certain to be followed by a high proportion of crop failures from wireworm attack.

The Specialists Help For several years before the war some of the advisory and research centres, notably those at Cambridge, Manchester, Rothamsted and Wye, had been studying different aspects of the wireworm problem and had used various methods for the estimation of wireworm populations. By 1938 advisory entomologists were asking such questions as "Will it be helpful, in the event of extensive breaking of grassland, to have fore-knowledge of the wireworm populations of grass fields ? " and "Are any of the methods in use for estimating wireworm populations likely to be sufficiently reliable and speedy for general use ? "

A year's work at advisory centres throughout the country, co-ordinated by the staff of the Ministry's Plant Pathology Laboratory and assisted by members of the statistical department of Rothamsted, supplied answers to these questions. It was found that effective wireworm populations could be estimated with reasonable speed by an approved system of sampling and hand-sorting. Though this method lacked the accuracy of a laboratory method, it could be used in the field or in barns, sheds, glasshouses or any other available shelter. Although its limitations were recognized, its use provided a means of grouping grass fields scheduled for cereal production into four classes of expected crop performance, according to the level of the estimated wireworm population.

Table 1

Wireworm Population	*Expected Crop Performance*
Low	Successful
Moderate	Moderate
High	Poor
Very high	Failure

Since crops were known to vary in their susceptibility to wireworm attack, knowledge of wireworm populations could be used to determine choice of crop as well as choice of field.

A National Survey These considerations led to the decision to undertake a general survey of grassland to be ploughed. The advisory entomologists and their staffs surveyed the scheduled fields and made estimates of wireworm populations. Their reports, often coupled with soil analyses, were then sent to County War Agricultural Executive Committees or to farmers for their guidance. By the end of 1943 about half a million acres had been surveyed, and crop performance on surveyed fields had been recorded. In this way the wireworm survey served a double purpose : it provided valuable information on the choice of grassland to be ploughed and its cropping, and revealed that some of the losses from wireworm attack could be related to farming conditions. In demonstrating the connexion between fertility and intensity of wireworm damage, the survey gave a clue to the practical solution of the wireworm problem.

Wireworms in Ploughed-up Grassland It has been found that wireworms occur in practically all the agricultural land of England and Wales, and that while the common wireworm, *Agriotes obscurus*, is generally dominant, in many localities allied species occur in large numbers. The survey indicated that wireworm populations were generally higher in the South and East, but fields with high populations occurred in almost every part of the country. Though there was no reliable association between wireworm populations and the nature and texture of the soil, high wireworm populations were met with more frequently in heavy soils than in light land. This may be the result of different moisture conditions, for light soils tend to lose moisture quickly and may dry out in late spring and summer, while heavy soils tend to retain moisture throughout the year. In the South and East, where rainfall is low, light soils in Surrey, Sussex, Norfolk and Suffolk are generally associated with low wireworm populations, but in Devon, Somerset, Glamorgan and Monmouth, where rainfall and humidity are high, considerable wireworm populations may occur in almost any soil in grassland under good agricultural management, although the general level of wireworm population is low.

The wireworm survey also gave interesting information on the proportion of grassland heavily infested with wireworms.

Table 2

Wireworms per Acre	Grassland.	Group	Risk to Crop
	per cent.		
Up to 300,000	50	Low	Little
325,000–600,000	33	Moderate	Moderate
625,000–1,000,000	12	High	Serious
Over 1,000,000	5	Very high	Very serious

It was of considerable assistance to those concerned with food production to know that on about half of the newly broken grassland there was little risk of crop failure from wireworm attack. On about one-third of the land the risk was substantial but not serious, but in one field in six wireworms were likely to be a serious menace to crop production. Since neither geographical position, nor soil character, nor previous management gave a reliable clue to the wireworm population, the farmer and his technical advisers found the assistance of wireworm survey teams very helpful. With their help in ascertaining the wireworm population it became possible for the County War Agricultural Executive Committees to arrange cropping and the distribution of available fertilizers in such a way that risks of crop failure from wireworm attack were reduced, with the result that farmers gained confidence in their ability to obtain satisfactory crops on wireworm-infested fields.

Plant versus Wireworm To understand the part played by wireworms in causing crop failure, it was important to know something of the plant population in fields under observation. In Britain seeding rates for cereals vary from 2 to 6 bushels or 1½ to 3 million seeds per acre, according to the cereal used. If germination is satisfactory these rates give 1¼–2¾ million seedlings per acre or, at 8-in. spacing, 2–4 seedlings per inch. It is known that yields above the average for Britain have been obtained from stands of 300,000 to 500,000 wheat plants per acre when other conditions were satisfactory. The difference between

the number of seeds sown and the number of plants necessary for a satisfactory crop indicates that the farmer provides a margin for such thinning as normally occurs.

Little was known about the thinning caused by wireworm attack, and it was thought that counts in growing crops would give the required information. Counts for the calculation of plant populations were made in many fields throughout England and Wales. Where conditions for close observation were satisfactory, the results showed an association between wireworm populations and the numbers of plants lost sufficient to indicate that the higher the wireworm population the greater the risk of crop loss. It has been suggested that an increase in the seeding rate will lessen the risk of loss of crop in fields with high wireworm populations, and the following Table and Figs. 1–5 (facing p. 461) link wireworm populations and seeding rate.

Table 3

WIREWORMS		SEEDING AT 2 BUS. PER ACRE		INCREASE IN SEEDING	
per acre	*per sq. yd.*	Seeds per sq. yd.	Seeds per wireworm	Bus. per acre	Seeds per wireworm
300,000	60	300	5	0	5
600,000	120	300	$2\frac{1}{2}$	$\frac{1}{2}$	3
1,000,000	200	300	$1\frac{1}{2}$	1	$2\frac{1}{2}$
1,500,000	300	300	1	2	2

Table 3 indicates how the farmer can improve his chance of having sufficient seedlings to produce a crop by increasing the seeding rate. The more seedlings there are in relation to the number of wireworms, the less the risk that their numbers will be reduced below those necessary for a satisfactory stand of plants.

As was expected (see Table 1) observations made in the course of the survey showed that crop performance was linked with wireworm population. Records for 1942, given in Table 4, show the steady fall in the yield, and the increase in the risk of failure as the level of wireworm population rises.

Table 4

WIREWORMS	NO. OF FIELDS	POOR OR FAILED CROPS	MEAN YIELD
		per cent.	*cwt. per acre*
Up to 300,000	291	21	21.1
325,000–600,000	223	30	19.7
625,000–1,000,000	109	44	18.0
Above 1,000,000	37	54	15.6

Cereals possess the power of tillering or producing side shoots capable of bearing ears. Where thinning by wireworms takes place, remaining plants have room to produce tillers to grow out and fill the spaces. This power of compensatory growth is influenced by the fertility of the soil. Where fertility is high, growth is rapid and usually adequate, but where it is low the capacity to compensate for wireworm thinning will be small. This seems to explain why crops are successful in some fields with high wireworm populations while similar crops fail in fields with lower wireworm populations.

Plough versus Wireworm The national survey gave an opportunity of examining changes in wireworm populations resulting from cultivation. Repeated counts in fields for successive years after breaking showed that the decrease in numbers of wireworms as a result of ploughing for arable crops was marked. The results of successive sampling for wireworms in about 100 fields before and after the first two crops in ploughed grassland are shown in Table 5.

Table 5

No. of Fields	Wireworm Population Range	Average Wireworm Populations (1,000s *per acre*)		
		1940	1941	1942
53	Up to 300,000	160	170	100
23	325,000–600,000	440	360	170
15	625,000–1,000,000	810	440	230
14	Above 1,000,000	1,380	710	270

The steady decrease in average wireworm populations is apparent, and the decrease is greatest where populations are high. Table 6 gives another expression of the fall in wireworm numbers after breaking. Here the figures refer to groups of fields in their first, second and third years after grass and not to the same fields observed continuously.

Table 6

County	Average Wireworm Populations		
	1st year arable	2nd year arable	3rd year arable
Herefordshire	764,000 (68 *fields*)	439,000 (53 *fields*)	328,000 (53 *fields*)
Wiltshire	512,000 (175 *fields*)	300,000 (96 *fields*)	156,000 (71 *fields*)
Worcestershire	498,000 (78 *fields*)	273,000 (24 *fields*)	181,000 (9 *fields*)
Gloucestershire	415,000 (76 *fields*)	170,000 (54 *fields*)	93,000 (53 *fields*)

Since the evidence of a rapid decrease in numbers of wireworms in grassland after breaking is conclusive, it is difficult to account for the belief that wireworm injury is greater to the second crop than to the first. Only if conditions are less favourable for the crop should fewer wireworms be associated with greater loss. This may happen where good ploughing, resulting in a firm seedbed and good consolidation, gives the first-year crop a satisfactory start, while the nature of the turf after ploughing in the second year prevents consolidation and results in an open, springy seedbed, and makes conditions unfavourable for the establishment and growth of the second crop.

A study of the yields from fields in which wireworm counts were made shows that yields of second crops of cereals are quite as good as those of the first-year crops, and that in some seasons they may be better. Table 7 shows wheat yields in 1941 and 1942 on fields in their first and second years after breaking.

Table 7

WIREWORMS PER ACRE	YIELDS IN 1941 (*cwt. per acre*)		YIELDS IN 1942 (*cwt. per acre*)	
	1st year	2nd year	1st year	2nd year
Up to 300,000	18.9	20.1	21.2	20.8
325,000–600,000	17.4	18.3	20.3	19.8
625,000–1,000,000	14.7	17.0	17.9	18.3
Above 1,000,000	11.6	18.3	14.2	17.6

Crops for Ploughed-up Grassland Crops other than cereals have been carefully observed under different levels of wireworm infestation. Flax (linseed) has been outstandingly successful as a crop on land heavily infested with wireworms. Though slight damage occasionally occurred, wireworm attack on the seedlings seldom affected the yield. With peas and beans the seed and the base of the stems are subject to attack, but under most conditions satisfactory yields have been secured on heavily infested land. Where pulse was included in forage mixtures, the peas or beans usually suffered less injury from wireworms than the cereal constituent. Root crops and potatoes usually occupy less acreage than cereals on newly ploughed grassland. When these crops are grown on new land the risk of wireworm injury is considerable, and the proportion of poor crops increases as the level of wireworm population rises. In East Anglia serious losses to sugar beet and mangolds occur, particularly in early sown crops, but redrilling after the initial attack is usually followed by successful establishment of seedlings.

Potatoes are a valuable pioneer crop on reclaimed land, for wireworm populations are seldom high and moderately clean produce is obtained. In old swards wireworm attack may be serious and may increase rapidly in autumn if the crops are left in the ground. Available evidence emphasizes the value of early lifting on light soils or where the wireworm population exceeds about 400,000 per acre.

Where direct reseeding has been carried out on ploughed grassland, observations have shown that the grass seedlings in the seeds mixture are just as subject to wireworm attack as young cereals, and where adverse factors retard establishment many seedlings may be killed. Usually, however, the rate of seeding makes good allowance for loss, and new leys can be established either directly or under a nurse crop, even on land with very high wireworm populations.

Recommendations For a general account of the wireworm survey and a discussion of many aspects of the problem of wireworms in relation to food production, the reader should consult Bulletin 128 prepared by the Conference of Advisory Entomologists and recently published by the Ministry of Agriculture.* From the account of the work it is evident that it is useful to know the effective population of grass fields to be ploughed for arable cultivation. With such information crops likely to succeed at that level of wireworm population can be selected, cultivation and fertility improved, and, if necessary, more seed used to increase the chances of successful cropping.

After consideration of the results of their survey, the advisory entomolo-

* *Wireworms and Food Production.* Obtainable from H.M. Stationery Office, price 1s. net, (1s. 2d. by post).

gists and their collaborators make the following general recommendations:

1. Where the wireworm population, as estimated by the hand-sorting method, is not more than 300,000 per acre, the fields are regarded as in the low population group and considered to be safe for all farm crops, provided that soil conditions, fertility and seed vigour are satisfactory. Potatoes may be successful but, even with low populations, serious damage to the tubers may occur.

2. Fields with estimated populations between 300,000 and 600,000 per acre are in the medium population group. These fields are safe for cereals when soil conditions, fertility and cultivations are favourable. Potatoes should be avoided except on medium and heavy loams, or where fields with low populations are not available. In this population group potatoes should be lifted early in September unless it is known that wireworm attack is not taking place.

3. Fields with estimated populations greater than 600,000 per acre are in the high population group and are regarded, particularly on light land or thin soils, as being risky for most farm crops, though good cereal and root crops are often obtained on the heavier soils. When conditions are favourable crops most likely to succeed are barley, mixed cereals with pulse, and pulse alone.

4. Fields having an estimated population of over a million wireworms per acre are in the very high population group, and such populations are dangerous for most farm crops. Though wheat and barley may be grown successfully in the presence of very high populations, the risk of failure is serious. Where cropping for safety is desired, peas, beans, flax, and linseed are most likely to prove satisfactory. Forage mixtures of cereals with pulse may also succeed on the heavier soils. Rape and kale as cover for seeds are often useful, and seeds for a one-year ley may be sown under beans, linseed or flax. Direct reseeding after a period of summer fallow may also be successful.

DOWNY MILDEW OF SUGAR BEET

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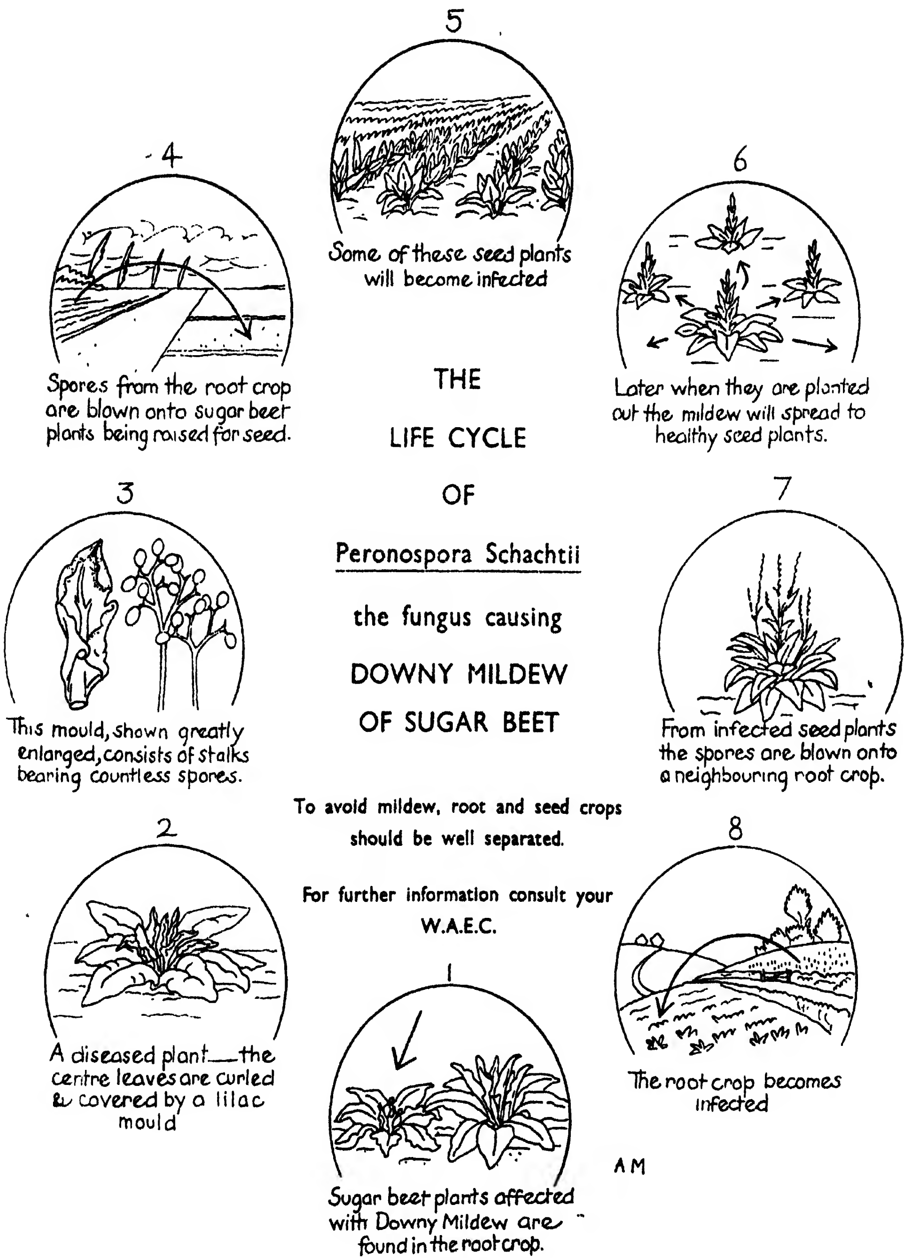
THE natural duration of life of a sugar beet or mangold plant is two years. In the first year it stores up food, chiefly in the form of sugar, and in the second it uses this to form a flowering shoot to produce seeds. At any stage in this life cycle the plant may be subjected to an attack by the spores of the fungus *Peronospora Schachtii*, which give rise to the disease known as Downy Mildew. If this develops the intensity of the disease will depend upon certain definite climatic conditions. In warm and humid weather the attack may be severe and, in the case of the root crop, there will be a loss in yield and sugar content. If, however, the crop is being grown for seed the consequence may be more serious, for the yield of seed may be markedly reduced.



[Copyright: *School o Agriculture, Cambridge.*

DOWNY MILDEW OF SUGAR BEET

Normally Downy Mildew is first observed in the field about June or July, on the young inner heart leaves, which are stunted, distorted and curled. If these are examined carefully a lilac-grey mould will be seen covering them, and at first this is usually on the under-surface. This mouldy appearance is caused by the fungus, and when observed under the microscope, it is seen to consist of delicate stalks bearing innumerable spores. It is these that are blown by the wind to infect other beet plants in the vicinity.

Occurrence of Disease How is the disease brought about each year? Theoretically it may arise from one of the following: (1) the use of infected seed; (2) special resting spores contained in the debris from a previous infected crop; (3) spores blown in late summer to young seed plants, and then back from these in the following year to the root crop.

There is no proof that in this country infection originates from the use of infected seed, but under former bad systems of rotation, where beet crops were taken in succession, it is not unlikely that infection resulted from resting spores in beet debris or from hibernating mycelium in undecomposed crowns. There is, however, considerable field evidence that severe attacks in root crops may occur when they are situated close to mildewed seed plants, and that seed plants become severely affected if they are grown in the immediate vicinity of diseased root crops.

Control Measures A distance of 400–500 yards should separate a root crop from plants being grown for seed. If a crop for seed must be grown nearer than this to a root crop, the relative situations of the two should be such that the prevailing winds do not first blow over the root crop and so carry spores to the young seed plants. Further, when these seed plants are set out they should be planted as far away as possible from any field where roots are to be grown. Any isolated diseased plants that are noticed should be lifted gently, a small hole dug, and the diseased plant completely buried with soil. It is a bad practice to lift such plants and then carry them away, because in doing so the spores are scattered and the infection spread.

AGRICULTURAL EDUCATION AT LADY MANNERS SCHOOL

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When the teaching of agricultural science was begun by the writer in Lady Manners School (in 1919), only one or two schools had given any thought to it as a school subject. Lady Manners School is situated in the rural district of the Peak of Derbyshire, and its students number about 290 boys and girls ranging in age from 10 to 18. The majority of the children travel to school by buses from the surrounding villages and farms. These farms are mostly of the family type and are devoted chiefly to milk production, sheep grazing and fattening, and some

beef production for the Christmas market; before the war they carried very little arable land. Many of the children attending the school are not academically minded, and about 21 per cent. of them return to the farms or take up some form of agricultural work. In general, Lady Manners School can be considered as a typical example of a rural secondary school on the fringe of an industrial area.

Since the introduction of the rural bias, interest in science work has increased, the examination results have improved, and a greater appreciation and liking for the country way of life has been engendered. The curriculum was originally planned to teach the principles of agriculture through the media of biology, chemistry, and some physics. The application of the bias has gone through a process of evolution, and is still evolving; at present the bias is applied to biology and not to experimental science. It was considered that as some boys and a few girls study science beyond the school certificate stage, a general course embracing more physics and some chemistry would meet the needs of the sixth form pupils, and, at the same time, provide a good ground work in the fundamental sciences for the biology course.

Co-education for First Three Years All the boys and girls take the same course in mixed classes for the first three years. They then have an option of subjects, from which they can select a group which contains all the science subjects, or they can drop the experimental science; all groups include biology. The girls may take domestic science instead of experimental science if they so wish. A full account of this scheme of education has been described by the writer in the journal of the Agricultural Education Association, *Agricultural Progress*, 1944, Part 1. At the end of the fifth year all the students sit for the school certificate examination, which includes a special biology paper.

Agricultural biology is divided into laboratory and field work. The school has some three acres of land for experimental purposes. The biology course in the first two years of the child's school life embraces animal and plant biology, and is designed to teach fundamental facts and principles about the physiology of living things and to give some idea of the diversity of animals and plants. Some field work and a certain amount of work on the garden plots is included.

No text-book is used for the first two years, but readers are provided for private reading, and sometimes for class use when a particular plant or animal is being discussed. The books used for the first year are the *Look and Find Out* series, and for the second year, *A Year with Nature*, by J. E. Roberts, together with the booklets published by the National Federation of Young Farmers' Clubs.

In the third year, besides ordinary biology an introduction is made to the study of milk, insect life and rotations of crops for the farm and garden; a greater amount of work is also done in the garden and on the experimental plots and orchard.

Special Syllabus in Fourth and Fifth Years In the fourth and fifth years the special syllabus in agricultural biology for the school certificate examination is started. The course is essentially practical; laboratory experiments and dissections are supplemented by experimental and practical work out-of-doors. The syllabus is divided for the sake of convenience into three sections: (1) plant biology, (2) animal biology, and (3) soil science.

Plant and Animal Biology In plant biology, stress is laid on reproduction and growth, seed and fruit production, and vegetative reproduction, including cuttings, budding and grafting. Study of the composition of plants, the foods they contain and how they are made, the elements found in the dry matter and in the ash, leads to the principles of manuring and the composition and use of fertilizers. The effects of fertilizers on different crops are demonstrated by means of pot experiments with poor soil and by field experiments on meadow hay and arable crops.

Animal biology centres around the biology of the rabbit taken as a mammalian type. All the systems of the rabbit are dissected by the class, and comparisons are made with farm animals—particularly the processes of digestion and reproduction. A detailed study of the composition and chemistry of milk serves as an introduction to the principles of nutrition and rationing. In discussing milk secretion, reference is made to the points of a dairy cow and the causes affecting variations in the composition of milk. This latter is illustrated by determinations of the fat percentages in milk samples brought by the pupils from cows in different stages of lactation, from different breeds, morning and evening milk, first-drawn and last-drawn milk, etc. The production of clean milk and methods of testing for the degree of cleanliness are demonstrated. Visits are made to farms for the purpose of studying practical methods at first hand, although during the war these visits have had to be restricted to nearby farms.

Insect Life The study of insect life is based on the external features of the hive bee and its development. The principles of bee-keeping are taught by practical work in the school apiary. The digestive and nervous systems of insects are studied by the dissection of a cockroach.

Soil Science and Soil Micro-organisms Soil science deals with the study of the formation, structure and composition of soils; how a soil is adapted for the growth of roots, and the principles underlying the fertility of the soil—such as soil reaction and the use of lime, drainage, the maintenance of humus and the production of seedbeds to suit different crops. Practical work consists of a visit to a quarry and the study of the soil profile; simple mechanical analysis by sieving and sedimentation; testing for soluble matter and nitrates in soils; the hygroscopic water and the loss on ignition; and testing the soil reaction by the B.D.H. soil indicator. The properties of sand and clay are shown by simple experiments, including the effects of lime and burning on clay. The water-holding, drainage and water-raising powers of sand, clay and a peaty soil are compared. The soil mulch is discussed and demonstrated, and factors influencing the temperature of soils include experiments on specific and latent heats. The effects of frost are studied in the field as well as the influence of humus on the structure of a clay soil. Pot experiments are made to show the effects of humus on the fertility of the soil by the addition of increasing amounts of rotted turf. The application of lime to acid soils demonstrates increased fertility, especially with acid-sensitive crops, such as barley and red clover.

Soil micro-organisms are studied in general under the microscope, and the rôle they play in the decomposition of dead plants and animals is discussed. Their results are shown by simple experiments in the production of nitrates in well-washed soil (i.e., soil free from nitrates at the start) and a similar sample of soil sterilized by heat. The effects of partial

sterilization with toluene or formalin is demonstrated by means of pot experiments. The production of carbon dioxide and ammonia in farmyard manure serves as an introduction to the more detailed study of the composition and value of this important farm product.

Work on Experimental Plots Pot and field experiments have been carried out for 25 years, during which time a fair amount of experimental evidence has been collected and is now used in the classroom teaching. In 1936 accounts of some of them were printed privately and have been in use ever since. Field experiments were started as small demonstration plots, but these were discarded in 1928 in favour of larger plots of about 1–1½ sq. rods. About ½ acre was ploughed and planted with savoy cabbages. The crop was very successful, and it was therefore decided to repeat it for a second year with the object of building up a reserve fund for the purchase of a motor cultivator.

In the spring of 1930 a 1½ h.p. machine was obtained and proved a great success, since it made us independent of outside help once the land had been ploughed. As time went on we purchased more implements for the machine, and we now have a ringed roller, disc harrows, a tined cultivator, a ridging plough, inter-row attachments for weeding, etc., and a plough which will turn a 3- or 4-inch furrow after the land has been tine-cultivated. To supplement this machine we have our hand implements, including a seed drill and two sets of wheeled hoes. In 1931 we remodelled our experiments on the field plans suggested by Mr. H. V. Garner of the Rothamsted Experimental Station.

Fertilizers Compared During that year we had four major experiments in progress: two on meadow hay and two on arable land. One of the meadow hay experiments was designed to show the effects of fertilizers supplying nitrogen, phosphates and potash used all together, in combinations of two, and as single dressings. This is generally known as the eight plot N.P.K. experiment. The plots were divided into three blocks, each block containing one of each of the eight treatments, which were randomized. This has proved to be a very valuable experiment for demonstrating the effects of complete and incomplete manurial dressings on the yield and composition of the herbage. The yields are also correlated with the rainfall and temperatures throughout the seasons. This experiment is now in its fourteenth year.

The other meadow hay experiment was one of a series carried out by Rothamsted on behalf of the Basic Slag Committee of the Ministry of Agriculture. Four phosphatic fertilizers were compared, making five treatments with the control plot. The five treatments were replicated in the form of a randomized Latin square. Unfortunately, owing to the rather wet nature of this part of the field, the results were not significant.

On the arable an attempt was made to manure the crops in a four-course rotation on the eight plot N.P.K. principle. Treatments on each of the individual crops were duplicated, making a total of 64 plots. After 3 years it was decided to simplify this experiment by growing only one crop at a time on larger plots. The rotation was modified to potatoes, kale, mangolds and ryegrass or crimson clover. The manuring was limited to four treatments, which were arranged in the form of a randomized Latin square, making 16 plots to each experiment. Two crops of the rotation were grown each year, so that the four crops were grown in two years. Each plot is 1 sq. rod. The treatments have varied on these arable crops, but one experiment was continued long enough to give satisfactory results before

the plots were re-randomized for another set of treatments. In this way we have tested dried poultry manure, nitrogenous fertilizers, increasing amounts of nitrogen, compost, dried sewage sludge, screened dust and farmyard manure. All the crops are weighed carefully and the results tabulated and sent to the Rothamsted Experimental Station to be statistically analysed and published. The results are discussed in class in the light of the modern statistical method, using the experimental error to test the significance of the results. In this way the boys and girls are initiated into the enlightened method of seeing the results of experiments and avoiding the pitfalls of drawing conclusions from inadequate data.

In 1932 a third experiment was started on meadow hay to compare the direct and residual values of an organic manure (composted grass mowings) with a complete artificial fertilizer over a period of two years. The plots are rather less than 1 sq. rod and are arranged in four blocks of nine treatments. This experiment is now in its thirteenth year. The results are compared with the winter rainfall to show the influence of a wet winter on the manurial residues left in the second year.

Fruit and Bee-keeping In 1938 new buildings were opened close to the experimental plots, and these enabled us to extend our work by the planting of an experimental orchard and the establishment of an apiary. A bee club, affiliated to the National Federation of Young Farmers' Clubs, has been formed. The members meet once a week in winter for lectures and discussions, and in the summer they are responsible for the management of the hives. Four members in the last two years have built their own hives and have now started on their own. After the war it is proposed to change the garden club into a young farmers' club and encourage the members to rear small live stock at home.

When the war came half of the arable land was turned over to the growing of vegetables, and more land was broken up to provide ground for garden plots. To carry out the extra routine work involved, a more powerful motor cultivator was purchased. This machine has given good service in the preparation of the seedbeds, and the smaller, older machine is used for ridging, inter-row cultivations and potato lifting.

This outdoor work is an essential part of the course and no extra time is allowed for it in the time-table, yet in the last three years there have been no failures in biology in the school certificate examination.

FARMING NOTES

Fixing of Agricultural Prices The following statement on the procedure to be adopted in fixing agricultural prices up to and including the harvest of 1947 was made by the Minister of Agriculture and Fisheries in the House of Commons on December 5, 1944.

In his speech in the House of Commons on January 26, 1944, Mr. Hudson said that there were three questions relating to the fixing of agricultural prices by the Government which he was willing to discuss with representatives of the industry :

(1) The collection of economic and financial data which would be acceptable both to the Government and the industry as a basis for price discussions.

(2) The procedure for using these data.

(3) The means of relating the system of guaranteed markets and fixed prices to the four-year production plan, including the harvest of 1947.

After discussion with the National Farmers' Unions of England and Wales, Scotland and Northern Ireland, and the Workers' Unions, agreement has been reached on each of these questions.

The economic data to be used for price discussions between Departments and the National Farmers' Unions will be based on Financial Accounts relating to different types of farming and sizes of farms and statistical material relating to costs of production, collected by means acceptable to the Government and the industry. These data will be made available to the Workers' Unions who will be given an opportunity of expressing their views.

ANNUAL REVIEW In February of each year there will be a review by the Agricultural Departments, in consultation with the National Farmers' Unions, of the general financial position of agriculture in the United Kingdom, based on the above economic and financial data and any other relevant statistical material which is available.

The price decisions reached by the Government following this review will apply (a) as regards crops, to the prices of crops from the harvest of the following calendar year—i.e., following the review in February, 1945, prices will be fixed for the crops from the 1946 harvest; (b) as regards milk, to prices from October 1 of the current calendar year; and (c) as regards live stock and eggs, to prices from July 1 of the current calendar year.

It is contemplated that during the period of the four-year plan ending in the summer of 1948, some change will be necessary in the character of our agricultural output to meet changing national requirements in the transition from war to peace. Broadly, the change will mean a gradual expansion of live stock and livestock products and a reduction from the high war-time levels of certain crops for direct human consumption.

MILK AND MEAT The Government have already announced their desire to encourage a substantial increase in milk production and a revival in the rearing of cattle and sheep for meat production. To this end an assured market and guaranteed minimum prices are being provided for milk, fat cattle, sheep and lambs, and calves produced during the four years up to the summer of 1948. Actual prices will be considered at each annual February review, and subsequently fixed by the Government.

The shortage of feedingstuffs occasioned by the war has necessitated a substantial reduction in pig, poultry and egg production. It is the intention of the Government to encourage an expansion of production of these commodities to the fullest extent permitted by the supplies of feedingstuffs which can be made available. A market will be assured throughout the four-year period for all fat pigs and eggs which are offered for sale. Prices will be considered at each annual February review and subsequently fixed by the Government.

CROPS An assured market will be maintained for cereals, maincrop potatoes and sugar beet up to and including the crops harvested in 1947. The prices of these crops will be considered at each annual February review and subsequently fixed by the Government.

It is recognized that in the event of an important change in the situation, such as might arise from a sudden and substantial change in costs, it may be necessary to conduct a special review.

The economic and financial data to be provided for the purposes of either an annual, or a special, review will include an appreciation of the economic and financial effects of any such substantial change in costs. There will be no automatic adjustment of prices; all relevant data will be taken into account and (except that no downward adjustment will, of course, be made in the guaranteed minimum prices for milk, cattle and sheep) the prices of all the above products will be subject to adjustment upwards or downwards.

Account will also be taken, in fixing these prices, of any changes that may be required during the four-year period in the character of the agricultural output. It must be contemplated that, concurrently with a relaxation of pressure—when this becomes possible—for the maximum production of certain crops, e.g., cereals and potatoes, prices of those crops will be reduced.

In the event of any modifications being considered necessary to meet the changing circumstances of the transition period, in the present methods and marketing machinery by which these assurances are implemented, discussions with representatives of the farmers and of the trades concerned will take place.

Separate consideration will be given to fruit, vegetables, early potatoes, wool, flax and hops.

Better Dairy Rations As from January 1 until the end of April next, the rations allowed to dairy farmers against milk sales will be altered to 4 units per 105 gallons, coupons being issued in the ratio of 1 protein to 3 cereals. This change will not affect the total quantity of the ration, but the quality will be improved by the inclusion of a percentage of maize in the cereal portion. There will be no change in the monthly deductions of 15 gallons per cow and 48 lb. of cereals per cow that are at present made in calculating rations. A corresponding alteration will be made in rations for milch goats.

Broad Red Clover Owing to unfavourable weather for harvest, it is likely that supplies of broad red clover seed will be smaller than usual. Consequently it is recommended that the seeding should not exceed 8 lb. per acre. For a crop of pure clover to be successful at this relatively low rate, there are three pre-requisites—a sweet soil, a fine, solid seedbed, and phosphate. An alternative would be to mix the clover with about ½ bushel of ryegrass and broadcast. The crop might be grazed reasonably in the first autumn, and if a seed harvest is desired it can be grazed in the following spring until (in the eastern counties) mid-May, or the early growth may be cut for hay.

Rural Community Sense The rural community, and the farm housewife in particular, is all too often unaware of the instruction and advice which can be obtained on a variety of subjects through organizations in the county. It is common knowledge that a few years ago a farmer might live only a few miles from the county town and never know that an advisory service existed. War-time propaganda and the work of the War Agricultural Executive Committees have largely

altered that, but in many places there is still ignorance as to other facilities which are available. Particularly is this the case with women in the agricultural industry.

The East Kent Federation of Women's Institutes recently organized a *Countryman's Exhibition* at Ashford, the main purpose of which was to show the kind of help available through the Women's Institutes and other bodies. The Federation had the co-operation of the County Agricultural Education Committee, whose advisers on horticulture, the keeping of poultry and small live stock, dairying, and other subjects, had staged interesting exhibits on stock-feeding with war-time rations, identification of garden pests and friends, and farm weeds and their control. The Education Committee, which is starting classes in agriculture and horticulture in several Technical Schools, gave information about the help available to young workers on the land and also showed a collection of new and interesting books from the County Library. The Young Farmers' Clubs also showed photographs and specimens of their work. A domestic section of the exhibition included cookery by the Ministry of Food, fruit preservation by the Women's Institutes Preservation Centres, and bacon-curing by the Rural Domestic Economy Instructresses of the Kent Agricultural Committee's staff. A selection of Ministry of Agriculture films was also shown by the Ministry of Information.

Other indications of the activities of Women's Institutes included a market-stall on the model of those which have been in existence in the county for many years, and which are run on a purely co-operative basis to take produce from small producers. Basket-making and the making up of rabbit skins—crafts which are widely practised in Kent—were also demonstrated. Demonstrators from Women's Institutes are available for classes in these subjects.

The greater the interest evinced by the rural population in the work of these organizations, the more firmly will the community sense be established and co-operative achievement proceed from strength to strength.

NOTICES OF BOOKS

This Farming Business. FRANK SYKES. Faber and Faber. 8*s*. 6*d*.

Mr. Sykes, who farms and manages 3,500 acres in South Wiltshire, aims, in this his first book, to get his views on farming influenced, as he admits, by clever farmers and scientists, accepted by other farmers and the general public. He has also endeavoured to give the townsman a simple picture of British farming. How far he has succeeded is open to question, especially in the first objective. His descriptions of country people, and especially the farm worker and smaller farmer, are rather patronizing and disparaging, and in every case they are wedded to some very glaring inconsistencies. As far as the townsman is concerned, little has been achieved except to "make confusion worse confounded".

The author's views on such subjects as marketing and ley farming may claim attention, although some are open to question on technical grounds.

The book can perhaps best be described as partaking of the nature of the proverbial curate's egg, but one is left with the firm impression that, on balance, the author has rushed into print rather hastily.

Disraeli and the New Age. SIR R. GEORGE STAPLEDON. Faber and Faber. 10*s*. 6*d*.

Of the few British statesmen who have survived the dissection and analysis of the historian and biographer, Disraeli ranks high in the list. Like Pitt, he has etched his personality deep in the heart of the nation, and the high ideals which found expression in his eloquence have, as Sir George Stapledon shows in this book, a marked applicability to present conditions and future hopes. Certainly Sir George finds much in common with Disraeli, and by adroit quotation from his speeches and writings proceeds to enunciate the fundamental principles upon which a new age must be built. It is beyond question that he has done it supremely well. These principles are, in his own words, ". . . based on the needs of our human nature in its totality—spiritual, mental and physical"; and it is human nature which finally determines the success or failure of mankind's endeavour in any sphere.

Against a background of pre-war complacency, Sir George (and Disraeli vicariously) examine this England of ours and all that affects the spiritual, mental and physical well-being of her people. Our present wakefulness has been stimulated by national danger, but we can learn from the lessons of the past as well as of the present if we have the will.

In no sphere of activity is this more clearly seen than in agriculture, which was cast into the discard in a moment of commercial intoxication. Disraeli saw the need to maintain a just balance between agriculture and industry: "I wish to see our national prosperity upheld alike by a skilful agriculture and by an extended commerce". Sir George defines "a just balance" as a sufficiently large agricultural-rural population in comparison with the industrial-urban population. The land and its stock have throughout history exercised an important influence on the character of our people, and that influence must be retained in the new age. Tactical considerations of political science and economics, claims Sir George, must not be confused with the strategy required to raise the level of our civilization to a higher plane.

This is a book to read and ponder. We all know Stapledon the scientist; here we have an introduction to Stapledon the man. The philosophy which he inculcates obviously derives from his love of the land and faith in his fellow-men. In conclusion he associates himself with these words of Disraeli: "The fate of England is in the hands of England; and you must place no credit on those rumours which would induce you to believe that you have neither the power nor the principle to assert that policy which you believe is a policy of justice and truth."

The American Land—Its History and its Uses. WILLIAM R. VAN DERSAL. Oxford University Press. 21*s*. 6*d*.

Mr. Van Dersal has, in this well-illustrated book, given us a very readable account of rural America—its farms, crops and live stock, its forests, its National Parks and its game sanctuaries. The United States is very large; its wheat fields alone would more than cover Great Britain, and its maize fields the whole of the British Isles. It has also a very wide variety of soils and climates, of natural types of vegetation and of crops It has orange groves and sugar-cane plantations, date, olive and peach orchards, cranberry bogs and maple sugar "bush". At one time it had its "long-grass" prairie (now the corn belt) and its "Great Plains" (now wheat country or livestock range).

The book recalls the many contributions which the old American peoples have made to the world's agriculture. They gave us maize and potatoes, long stapled cotton, tobacco, tomatoes, French beans and many minor vegetables. America is also, of course, the home of the turkey.

As the reader turns the pages, his mind will be swung between two emotions. He will admire the energy and drive which have gone to the development of the country. On the one hand was the incredible courage and endurance of the pioneers who carved their farms out of the forest or the grassland; on the other was the skill and resource of the irrigation engineer, the implement inventor, the plant breeder, and many other appliers of science.

But he will also be aware of the frightful waste of resources that went on in the process. We are told of the age-old oak and walnut trees that were felled and burnt or left to rot; of the lumbermen who have been allowed to exploit the forests and to leave devastation behind them; of the fifty million acres of once good soil that will not be fit to farm again for a thousand years.

America is now, indeed, struggling towards an all-round conservation policy. Some rather badly eroded land is coming back faster than the experts thought possible, but the process of soil destruction is still, probably, going on faster than that of restoration. Here and there forest utilization is being put upon a sound basis, but

the country, as a whole, is using its timber twice as fast as it grows. The State has taken control of a large area of land, and much of great natural beauty is being preserved; but private individuals have still, by and large, the right to do what they choose with land that they own.

It is a story of great achievement, but it has its tragic side.

Year Book of Agricultural Co-operation, 1943-44. VARIOUS AUTHORS. (Horace Plunkett Foundation). Manchester Co-operative Wholesale Society, Ltd. 15*s*.

The difficulties and preoccupations of the times have caused a break in the annual series of Year Books, which for seventeen years (1925–41) have so usefully recorded the development and activities of agricultural co-operation in every part of the world. The present volume covers the two years 1942 and 1943. The pervasive effects of war might well have imposed an almost fatal restriction on the scope of a survey relating to these critical years, particularly in the case of the European countries, the most co-operatively minded of all the Continental group, but fortunately circumstances which closed one source of information opened another.

In April, 1943, the British Association for the Advancement of Science arranged a conference on "Co-operative Systems in European Agriculture," to which contributions were made by speakers from sixteen European countries, including all those in enemy occupation. The Conference papers, hitherto available only in summary form, are here presented in full, and occupy about half the book The general intention of the Conference was to try to assess the right lines of future development of agricultural co-operation in the European countries by a realistic review of the past The approach is attractive but it is not so simple as it sounds, and the papers, with one or two exceptions, rest content with pure description and are not sufficiently analytical to meet the purpose fully. Discussion perhaps helped to remedy this defect, and its inclusion here, if only in summary form, might have provided a valuable corrective.

One is always impressed by the remarkable diversity of co-operative activity in Europe, and while some of the forms would scarcely have won the commendation of the Rochdale Pioneers (whose centenary is being celebrated this year), they do reflect the particular historical tendencies of the countries concerned, and therefore provide the obvious starting point for post-war improvements. Given a renewal of faith in democratic institutions in Europe after the war, and a pattern of farming which will comprise in the main small units under peasant ownership (individual in some cases, communal possibly in others), the right conditions should exist for further development of agricultural co-operation But what has been the effect of the Nazi domination of Europe?—has it fatally undermined the whole structure and organization of agricultural co-operation?

In the free countries (and happily in nearly all the neutral countries also), it can be said with confidence that the movement will continue the steady growth which war-time controls have inevitably checked, for co-operative organization has had a big part to play and its prestige is, on the whole, high. But much more caution is necessary in assessing the position in the recently occupied countries. It seems doubtful whether much of the co-operative machinery has been deliberately destroyed under German rule, but it has suffered a varying degree of regimentation which may have drained some of its vitality Margaret Digby in an interesting paper on "Co-operation, Relief and Reconstruction" sums up the position thus: "The Co-operative, with other economic forms, have been used to distribute rations and collect produce. Whether this will have any particular effect on their future, whether their continuance as one of the rare remaining forms of association among the conquered has made them centres of underground national life—as they were in the earlier periods of Polish and Czech subjections—or whether their part as unwilling instruments of German economic policy will have alienated their own supporters, cannot be known till the war ends.

The other articles maintain the high standard of previous Year Books, and altogether this is a volume that no one at all interested in agricultural co-operation would wish to be without.

The Farm in the Fen. ALAN BLOOM. Faber and Faber. 10*s*. 6*d*.

The farm which is the subject of this book had fallen upon evil days—in fact, it was probably an exaggeration to call it a farm at all when Mr Alan Bloom went there, and it is at this time that he starts his story. Like many of us, Mr. Bloom has been enjoying the thrills and pleasures of land reclamation in its initial stages; to grub up the bushes and put in the plough is like painting an old barn door—you can see where you have been and it shouts for itself. But you cannot hurry Nature; farming is a long-term job; it seldom goes with a swing. Nor does this story of bushing and

dyking, sowing and reaping. It is a laborious account of continuous hard work. Mr. Bloom does not give us the figures and data which would be so helpful and interesting to the practical reader.

A strong appeal is made for the future: that land shall not again be forced out of cultivation by circumstances outside the farmer's control, such as, in this case, the failure of the local drainage works. It is indeed a sad commentary that fenland within three feet of the clay, some of which had been clayed and was capable of growing heavy crops of both corn and roots, should have become practically derelict. As Mr. Bloom says, it must not happen again.

We wish him good luck and good yields.

Insect Pest Resistance in Plants—Bibliography. IMPERIAL BUREAU OF PLANT BREEDING AND GENETICS. 1*s*. 6*d*.

In the gradual development of superior crop production, the work of the plant breeder and geneticist in evolving types resistant to damage by insect pests, is of fundamental importance. This new bibliography of over 550 references presents an up-to-date survey of the more recent findings in this field of research, as well as a guide to the results of earlier work. The references are conveniently grouped according to subject and include publications from the British Commonwealth, the U.S.A., South America, the U.S.S.R. and the main European countries. Unquestionably it will be of the highest value to research workers concerned with improved crop production.

BOOKS RECEIVED

Country Planning: A Survey of Rural Problems. Oxford University Press. 7s. 6d

Palestine: Land of Promise. W. C. Lowdermilk. Gollancz. 4s. 6d.

Livestock Improvement. J. E. Nichols. Oliver and Boyd. 10s. 6d.

Outlook for Farming. Lord Addison, C. S. Orwin and Doreen Wallace. Fortnightly Review. 1s.

List of Common British Plant Diseases. Plant Pathology Committee of the British Mycological Society. Cambridge University Press. 5s.

Index to the Literature of Food Investigation, Vol. 15, No. 2, September, 1943. Department of Scientific and Industrial Research. H.M. Stationery Office, 4s. 6d.

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CALF-REARING BY NATURAL METHODS

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THERE is an old saying, familiar to most farmers, that one gallon of milk from the cow is worth two from the bucket, and, as with so many of these old proverbs, there is a great deal of truth in it. After all, Nature never intended the calf to obtain its nourishment other than direct from its own mother, and the nearer we approach to natural rearing methods the better the results we shall obtain and the less trouble we shall have. Everyone will agree that of all systems of calf-rearing none is so satisfactory as suckling, for under this system the calves suffer fewer setbacks and thrive and grow more quickly; moreover, this method has the advantage of being practically foolproof. Milk drawn by the calf direct from the udder is clean, it is at the correct temperature, and, as it is consumed only in small mouthfuls instead of in gulps (inevitable in bucket feeding), it is more easily digested.

Nature's Way The simplest of all calf-rearing methods is, of course, the suckling by a cow of her own calf—and her own calf only—throughout the whole lactation. This, however, is expensive, and the calves are inclined to grow up wild unless frequently handled. Normally the method is confined to pedigree beef herds and to the production of commercial cattle in districts where plenty of cheap, rough grazing is available, and where the cost of maintaining the cow, both in winter and summer, can be kept low. With such a system the annual output is so small—one weaned calf per cow—that the utmost economy has to be practised if it

is to be in the least profitable. It is a system, therefore, that must always have a limited application, although I confess that in the depth of the last agricultural depression, when, apart from dairy cows, the feeding of almost any sort of cattle seemed hopelessly unprofitable, I kept such a herd on a mixed farm in Cambridgeshire, and by its means I was able to convert a loss on the feeding cattle account into a small (a very small) profit. Further, I found the herd to be of great use in the management of grassland, for they are the one class of stock which can, without serious loss, be forced to eat unpalatable material and to clear up rough grass which other animals would reject. In those days it was always possible to deal with the roughest of rough patches in any field merely by putting in the beef cows and keeping the gate firmly shut until they had completed their allotted task.

A calf reared on its mother under good conditions, up to the age of five or six months, has an ideal start for a career of beef production. Such a calf will probably consume 150–400 gallons of milk, according to the milking qualities of its dam—a point far too often overlooked, for the value of the calf at weaning depends largely on the quantity of milk it has received during the suckling period. The milking capacity of a beef cow—in a commercial herd at least—is an important consideration, and one that deserves far more attention than it usually receives. Having run out at grass with its mother all the summer, the calf will have had the advantage of receiving this amount of milk in a succession of small feeds—perhaps six or nine every twenty-four hours. Thus, in such a case, the golden rule of little and often will have been abundantly fulfilled.

Rearing by Nurse Although the advantages of this simple and primitive method are obvious—at least from the point of view of the calf—it is clear that it can never have a general application, because of its very low financial return. It is possible, however, to combine many of the advantages of this system with a cheaper method, and one which greatly increases the output and is capable of much wider application— that is, the system of rearing on each cow a number of calves instead of only one. In its simplest form this may only mean rearing two calves per cow, in which case but little modification of the single calf method is required. The cow's own calf is removed as soon as it is born (in spring) and only admitted to suck along with a second calf. In this way most cows will readily adopt the second calf, and in a very short time they may be turned out to grass with both calves. With refractory cows the calves are sometimes chained together when turned out, so that both get equal opportunities of sucking. This procedure, however, is attended by certain obvious risks.

Intensive Nurse System With the more intensive system relays of calves are used, anything from four to twelve being reared by each cow, according to the cows' milking capacity. The folly of using diseased cows for this purpose cannot be over-emphasized. The fact that they may be old does not matter, or that they are hard milkers, or even that they may have "dropped" bags. They must, however, be healthy, and the better the cow the better the results. No calf is suckled for more than three months, and the number of calves which a cow will suckle at a time naturally depends on the amount of milk she is giving at that particular stage of her lactation. The aim is to ensure that each calf gets a little more than a gallon of milk each day; thus a cow that is giving about 4 gallons of milk will probably be given three calves, and one that is giving between 2 and 3 gallons, two calves, and so

on. An example of the method as applying to an individual cow is as follows:

1st week of lactation	First (own) calf suckled; second calf introduced at end of week.
3rd " " "	Third calf introduced.
11th " " "	First calf weaned. Fourth calf introduced.
13th " " "	Second calf weaned. Fifth calf introduced.
15th " " "	Third calf weaned.
23rd " " "	Fourth calf weaned. Sixth calf introduced.
26th " " "	Fifth calf weaned.
38th " " "	Sixth calf weaned.

It may be simpler to wean the first three calves together at the thirteenth week, follow with a pair which will be suckled for a further 13 weeks and finish with a single calf. With a really good cow, four calves may be followed after three months by another batch of three or four, with a final pair to finish.

This intensive rearing system demands care in getting the cows to take the foster calves. Cows vary greatly, some readily adopting almost any calf that is given them, while others are very troublesome; in the latter case the attendant must stand by and restrain them as far as possible from kicking. When the cow is tied by the head it is remarkable how skilful a calf becomes, as soon as it is a few days old, in avoiding her unkind attentions; and it is still more remarkable how little harm is done by any kicks that may unfortunately get home. Some few cows never take kindly to any calf other than their own and remain spiteful to the end. Such cows are by temperament unsuited to act as foster-mothers and should not be used for this purpose.

Such a system of calf-rearing can be pursued equally well at all times of the year, for the calves do not run with their foster-mothers but remain indoors. In the absence of the cows they are encouraged to eat a suitable mixture of concentrates as early as possible (about the fourth week), and as much good, sweet meadow hay as they will. In this way they will be eating nicely when the time for weaning arrives, and they will suffer no severe setback. The growth of calves is sometimes retarded through their having too little to drink. If they are not getting enough fluid in the form of milk, they should be given water (at first warm) regularly and punctually.

Accommodation It cannot be denied that this method of calf-rearing demands suitable accommodation. The ideal is probably a box for each cow, into which she comes at milking time. In the box live the calves which she is suckling, while their foster-parent is at pasture in the summer or yarded in the winter. The boxes must be cleaned out at frequent and regular intervals, for calves should not be kept with the same accumulation of litter under them as is permissible with older animals.

Where boxes are not available, the cows can be brought into a milking shed at milking time, tied up and fed. If there are a good many cows in the same shed it may be advisable to tie their hind legs quickly before the calves are let in. Adjoining the milking shed, with a communicating door, there should be a large airy shed in which the calves are housed. They soon learn to run through the door as soon as it is opened at feeding time, and the attendant stands by to see that each calf goes to its right place.

This method has the advantage that one man (or woman) is able to superintend a large number of calves feeding simultaneously. Doubtless there are other methods adjustable to various conditions of housing.

It is an advantage if the calves are suckled three times a day, but this means more labour. When, as with this system, cows and calves live apart, the difficulty of getting the nurse cow in calf again (a difficulty often associated with cows suckling calves which are running with them) does not seem to arise, and it is generally found that the cows will behave in much the same way as they do when being milked by hand.

Conditions must Decide the System From what has been said the advantages and disadvantages of this method of calf-rearing are plain. It is clearly not a system that is equally suitable under all conditions, but calves so reared thrive and develop amazingly well, and a good start in life is all-important. Given that, they may subsequently be treated with some degree of severity and yet continue to grow satisfactorily. Dairy heifers so reared will be found big enough to put to the bull some months earlier than their sisters reared on an artificial and less liberal system.

DEVON BEEF CALVES FOR NORFOLK

JAMES BAKER, N.D.A.

Norfolk War Agricultural Executive Committee

As much as one-quarter of the entire British crop of sugar beet is grown in Norfolk, producing at least 750,000 tons of beet tops and 40,000 tons of beet pulp annually. In addition, a large acreage of kale, turnips and mangolds is also grown, so that the root-feed position is good. The full value of these, however, can be recovered only by feeding to ruminants. When due allowance is made for the present head of dairy cattle and sheep, there is a potential supply of " roots " to fatten about 100,000 bullocks each winter. The actual number fattened has remained steady throughout the war, but it is estimated that, having regard to the stock-feed available, there is still an annual deficit equivalent to some 40,000 head of store cattle. Although some of the roots could, of course, be fed to additional sheep or cows, sheep for arable feeding are just as difficult to obtain as stores for beef production, and there is an ever-growing disinclination to breed them on arable farms.

Norfolk has, therefore, had to look elsewhere for stock to consume an appreciable part of its root-shift. At the same time, the small grassland acreage in the county is steadily being improved by the reclamation of derelict marshland, the encouragement of reseeding and the replacement of permanent pasture with temporary leys, so that the stock-carrying capacity for the summer should at least keep pace with any increase in the number of stock reared.

Fewer Stores Available For generations the county has had a considerable trade with Ireland, the north-west of England and, to a smaller extent, with the West Midlands for mature sheep and cattle, especially for winter fattening.

These supplies are no longer sufficient to meet present needs, and the Norfolk War Agricultural Executive Committee has had, therefore, to examine every likely source of additional supply. The possibilities of rearing more stores within the county appeared to offer the best prospects, provided suitable rearing calves of beef type could be obtained. A survey of the Norfolk collecting centres, however, indicated that the large majority of calves in the grading pens were of dairy types, and that no suitable beef-type calves were available.

There was a possibility that pure Hereford or Hereford × Shorthorn calves could be obtained from the West Midlands, but although a surplus of these beef-type calves was found at Hereford collecting centre last winter, their numbers fell off by the summer and calves were available only at prohibitive prices, especially having regard to the overhead charges which would be incurred in transporting these calves to Norfolk. Moreover, the policy of the Ministry is that only calves surplus to local requirements should be obtained from the collecting centres, and that no attempt should be made to secure calves on sale in the store ring in competition with local buyers, as this would result only in raising prices still higher.

Eventually a trial load of calves was obtained direct from Shrewsbury market. The calves were not specially selected, nor were they of a particularly suitable type. Some were dairy crosses, and affected with white scour.

Through the Ministry's Superintending Livestock Officer for the Far Western Division (formerly Livestock Officer for Norfolk), a plentiful supply of North Devon calves, 2–7 weeks old, was subsequently found in Devon, where they were being sent to the local fat stock collecting centres for grading and slaughter. A trial consignment of 30 calves made the 350-mile journey to Norfolk, and the two War Agricultural Executive Committees worked out the details of a scheme. The primary difficulty in Norfolk was to create a good demand for these calves, for many farmers had a natural prejudice against rearing a breed of calf to which they were unaccustomed. Personal contact and Press advertising, however, quickly resulted in a plentiful supply of orders, and the actual routine operational working was not unduly complicated.

Collection in Devon A representative of the Devon War Agricultural Executive Committee attends weekly at each of the local grading centres in North Devon, namely, Okehampton, Bow and Hatherleigh, and selects calves of good type and quality. The calves are then sent by lorry to a collecting centre at Holsworthy. The Devon War Agricultural Executive Committee is not in a position to keep these calves very long because of the difficulty of feeding and housing. At Holsworthy, which is conveniently situated to the railway, each of the calves receives one pint of milk in one pint of water. The total cost of handling the calves in Devon, including housing, feeding, transport and labour, has averaged no more than 3s. 6d. per calf. Each calf is inoculated by a veterinary surgeon against white scour with an anti-dysentery serum at a cost of 4s. per calf. This has been found to be very effective ; only in two instances have slight cases of scour been subsequently reported. Each calf is then tattooed in the right ear, and details of the marking and initial purchase price are telephoned to the Norfolk Animal Husbandry Officer, who at once allocates the calves on paper to buyers' requirements.

The calves are put on the train at Holsworthy at 3 p.m. and arrive in Norwich at 6.45 p.m. the following day. Cattle boxes were used for the first consignments, but more recently horse boxes containing 15–18 calves have been used, as the railway rates for special cattle boxes proved more expensive. Railway rates have varied from 15s. to £1 per calf, according to the vehicle used.

Distribution in Norfolk Taking the price as a measure of size, calves can be evenly matched in bunches. This greatly simplifies allocation on arrival, and the calves are distributed to waiting transport according to ear number without further sorting. This system has worked satisfactorily even in the dark, when only an electric torch is needed to verify the earmarking.

On arrival, the calves are either dispatched by road transport provided by the Machinery Department of the Norfolk War Agricultural Executive Committee, or buyers make their own arrangements with cattle hauliers. In most cases the calves have been safely installed in their new homes in all parts of the county within two hours of arrival at Norwich.

During the winter, and in view of the risk of delay by fog and the difficulty of road delivery at night, it has been found necessary to feed the calves with milk on arrival, and to keep them in the railway vehicle overnight, dispatching them by road early the following morning. Removing the calves to a building for the night would, it is thought, incur the risk of chills. Despite the long journey involved, the calves have invariably arrived in excellent condition, and so far not a single death has occurred in transit.

The average cost of these calves at buyers' premises in Norfolk has worked out at approximately £5 10s. per head, including all overhead charges. The number of calves purchased by individual buyers has varied from two to twelve each, and according to size and grading, the initial purchase price of the calves at the collecting centres has varied between £2 10s. and £7 per head. This allows ample latitude for meeting buyers' individual requirements—whether, for example, they have milk available for calf feeding.

From reports received, the calves have, in the main, given general satisfaction, and buyers have been well pleased with their transactions. Although this scheme is in its infancy, and the number of calves is but a small fraction of the full requirement, it has demonstrated that an organized inter-county transfer of beef-type calves can be effected without major difficulty.

It is too early yet to forecast any future for the scheme. Since operations commenced, the inflow of store cattle into the county through normal channels has shown a tendency to improve, and this factor may reduce the demand for calves.

FARMYARD MANURE - I.

DAVID BLACK
Bacton, Stowmarket, Suffolk
and
A. W. OLDERSHAW, B.Sc., N.D.A.
East Suffolk

WHY is it that whilst almost every farmer believes firmly in the value of farmyard manure, one sees so many heaps of it lying about on farms exposed to all weathers? It seems to be forgotten that rain washes out the most valuable ingredients—nitrogen and potash—and that drying out may lead to serious loss of nitrogen. The immense importance of the subject is evident from Sir John Russell's estimate that the farms of Great Britain produce between 15 and 20 million tons of farmyard manure every year.

The writers have had under observation the various methods of making farmyard manure up and down the country—from store cattle, fattening cattle, milking cows, horses, pigs and poultry—and everywhere it has been apparent that only a small proportion of the product receives satisfactory treatment. Much of it is made and stored in rough heaps in open yards, and very often these heaps are surrounded by brown liquor. In some cases heaps of farmyard manure have been left at corners of fields until they were covered with weeds going to seed.

Returns from Farmyard Manure The long-term experiments at Saxmundham Experimental Station, in Suffolk, afford valuable evidence as to the actual returns from the use of farmyard manure in a rotation of ordinary arable crops. Here 10 tons of farmyard manure per acre applied to the wheat in a four-course rotation have, over a period of 30 years since 1909, increased the average crops over "No manure to any crop" as shown below:

Crop	*Increases*	*Average Approximate Prices* 1909–39	*Approximate Value* £ s. d.
Wheat	Corn 7.4 bus. Straw 10 cwt.	Corn 48s. per qr. Straw £1 per ton	2 14 4
Mangolds	6 tons 15 cwt.	10s. per ton	3 7 6
Barley	Corn 5.0 bus. Straw 3 cwt.	44s. per qr.	1 10 6
Beans	Corn 8.6 bus. Straw 6 cwt.	44s. per qr.	2 13 4
			10 5 8

It will be seen that this has secured the remarkably high return of fully £1 for every ton of farmyard manure used. During the earlier years of the experiment mixed manure made in an uncovered dunghill was used, but later the manure was made in a covered shed, both by fattening and store cattle, and over the whole period it may be regarded as having been of average quality. Crops such as potatoes, sugar beet and brassicas, which are likely to give high financial returns, were not included in the rotation. Hence the monetary returns quoted err, if at all, on the low rather than the high side.

War-time shortages of labour and building materials may not allow much immediate improvement in the equipment needed for the making of farmyard manure, but if agriculture is reasonably prosperous after

the war there can be no doubt that owners and occupiers will endeavour to improve their farm buildings. Mr. L. F. Easterbrook, speaking to the Industrial Christian Fellowship in London, said that the provision of equipment for our dairying industry alone would require a capital expenditure of £200 million if it is to produce milk under proper conditions, and that the relevant sum for agriculture as a whole would hardly be less that £500 million. Of this a considerable proportion is undoubtedly needed for farm buildings, including better provision for the production of farmyard manure.

Liquid Manure Good liquid manure is rich in nitrogen and potash. A single season's trial conducted by one of us gave the following results on ryegrass and clover hay (principally ryegrass):

	Weight of Hay obtained per acre
No manure	1 ton 15 cwt.
16 tons farmyard manure from fattening bullocks ..	2 tons 3 cwt.
16 tons pure urine (containing no added water). This was obtained from the same animals which provided the solid farmyard manure	2 tons 19 cwt.

Ordinary liquid manure, such as often stands in a pool in an open yard, is very variable in composition, depending mainly upon how much it has been diluted by rain. It is estimated that 1,000 gallons of average liquid manure is roughly equal to 3 cwt. kainit and 1 cwt. sulphate of ammonia.*

Liquid manure tanks are generally considered the best way of conserving liquid manure, and many such tanks, fitted with chain pumps, have been installed throughout the country. Sometimes the liquid is pumped on to the solid manure, to be absorbed by straw. Where there is surplus straw the excrement and treading of animals is probably the best way of getting it into a suitable condition for application to the land. Alternatively, liquid manure can be carted on to the land by means of a liquid manure cart.

Liquid manure is best applied to land which is to be put under nitrogen- and potash-loving crops, such as potatoes, mangolds, sugar beet, cabbages, and grasses like ryegrass and cocksfoot. Although often used for old meadow hay, or even for grazing, it is not nearly as suitable for this as it is for new leys containing a good proportion of the taller grasses.

We have seen many unused liquid manure tanks on farms in the past few years, and a good number that are seldom if ever emptied. The most probable reasons for this are (1) the necessity for frequent emptying, (2) scarcity of labour, (3) the men's dislike of handling the material, and (4) the failure of farmers to realize the value of liquid manure.

Liquid manure tanks should be used only for pure urine; rain water should be excluded, and water from washing down cowsheds should be conducted elsewhere by means of a two-way arrangement. Present-day labour costs do not permit the carting out of very dilute liquid manure.

The liquid manure distributor is best fitted with rubber tyres, and the tap and distributing trough should be large—say, 6 ft. long and 6 in. × 6 in. in section. Twenty holes of about 1½-in. diameter should be made in the bottom of a trough this size.

*Growmore Leaflet No. 71, *Dung Must Not Be Wasted.*

A man pumping a chain pump filled a barrel holding 9½ cwt. liquid in three minutes. Mr. G. Hallam of Costock, Nottinghamshire, informed the writer that he and another man filled a tank holding 19 cwt., took it to an adjoining field and distributed it five times in two hours. He obtains very good results from its use and does not find the labour involved in pumping unduly heavy. Electrical liquid manure pumps offer interesting possibilities.

It appears that the most popular method of dealing with liquid manure is to get it absorbed by straw. Opinions differ, however: Mr. Cecil Amos of Costock, for example, would much rather watch an electrical pump fill a liquid manure distributor with a ton of liquid, and subsequently let it distribute itself in the field by gravitation, than he would fill a ton of solid manure by hand and afterwards spread it by hand. Many others are of the same opinion.

Mechanical loading and spreading of solid manure has not yet become common in this country, and when done by hand is very expensive and laborious. There is an abundant supply of straw in many parts of the country, and a number of experiments have been conducted to ascertain the best means of utilizing the surplus. Mr. H. V. Garner, reporting on the Rothamsted experiments, declared that they tended to confirm the general view that whenever conditions allow, farmyard manure is the best way of getting straw back to the land. Used in this way, straw conserves and restores to the farm valuable and rather fugitive materials which would otherwise be lost.

Losses in Making It has been proved by Dr. J. A. Voelcker, Professor T. B. Wood, and Sir John Russell, that the losses in making farmyard manure amount to about 15 per cent. under the most favourable conditions—i.e., when the manure is made from stall-fed fattening beasts and is left undisturbed and unaffected by drainage until it is carted out. No means are known of preventing this loss. Under ordinary conditions of storage much greater losses occur due to rainfall, moving the heaps, and dissipation of valuable nitrogenous compounds in the form of gas, but the above-mentioned writers show that it is possible to reduce these losses very considerably. At Rothamsted the losses from three heaps stored for three months were as follows:

	Percentage of Nitrogen lost
Very compact heap under cover	Nil
Ordinary heap under cover	6.9
Ordinary heap in open	24.4

These figures show that storage loss can be greatly diminished by compacting the heap and keeping it under cover.

Rain is the great enemy of manure heaps in the open, causing heavy loss, particularly in rainy districts. Where it is necessary to build manure heaps in the field, they should be made as solid as possible, then topped up to protect from rain. A layer of soil is an effective covering, but it involves labour. Rough thatch made of battens of straw would reduce loss due to rain, and would also tend to prevent drying out, which is a very real danger.

In May, 1944, one of the writers found a great deal of liquid oozing from a very large heap which had been erected in the open a few months

previously, although the weather had been abnormally dry. This heap had been drawn over and was extremely well made.

In some parts of the country it is a common practice to turn manure heaps; in other parts it is unknown. It is probable that the heat developed in the operation of turning kills a certain proportion of the weed seeds present. Turning also mixes the manure, promotes decay and rapidly causes long dung to become short. It must be remembered, however, that the loss of nitrogen is greatly increased by turning; hence it should be avoided wherever possible. Dr. J. A. Voelcker and his colleagues conducted an experiment in which two heaps of manure were turned and left for three months. One heap which was left loose and completely sheltered lost 27.7 per cent. of its nitrogen; the other, which was left compact, lost 13.9 per cent.

Time of Application The date at which farmyard manure can be applied has an important bearing upon the method of storage. On medium and light land and in districts of heavy rainfall a large proportion may be applied in late winter and early spring for roots and similar crops. This enables the farmer to use manure made in winter for the crops of the following summer, and so to turn over his capital more quickly. In districts of heavy rainfall it is probable that unrotted manure may be used with greater safety. It is also frequently possible to apply the manure in spring where market-garden and similar crops are grown, but the ploughing in of rather dry, strawy manure into dry soil in spring may easily result in a reduced crop. It may be possible, in January, to apply farmyard manure for spring beans. In dry or frosty winters freshly made manure may be carted even on to heavy land. On light and medium soils there are more opportunities for this. On heavy land, however, the necessity of having a winter mould for crops such as mangolds and sugar beet means that the manure must be ploughed in during the autumn; therefore it must be manure produced during the previous winter.

When the winter's manure has to be stored until the following autumn, it is best, from the point of view of the conservation of its valuable ingredients, to leave it where it is made—in a covered yard or covered dungstead. Unfortunately it is impossible to get everything done in the autumn. Hence to relieve the pressure of work at that busy season, it is often carted out from yards and made into a dunghill in the open, near where it will be required. This involves extra labour and leads to greater loss by drainage and evaporation; but it is difficult to see how it can be avoided. Also yards sometimes get too full of manure, in which case it has to be carted out. When bare, half, or pin fallows are made the manure may be carted direct from the yards and applied before the last ploughing in preparation for an autumn-sown crop, or it may be applied to second-year leys in summer, or to the land from which a crop of seed trefoil or white clover has been removed, just before breaking up.

When manure is applied in summer and is not immediately ploughed in, there is great danger of it becoming thoroughly dried out. It seems very likely that this results in serious loss of nitrogen into the air, but the writers are not aware of any scientific work on the subject.

Part II of this Article will appear next month.

DRAPER TURNED FARMER

F. C. Hynard
Eynsford, Kent

STARTING in 1910 as a small draper, I found myself in 1918 with a successful business but badly affected with tuberculosis, in consequence of which I had to spend seven months in a sanatorium. I was advised to seek an outdoor occupation, and accordingly I sold my business and went to British Columbia to investigate fruit-growing. I quickly realized, however, that it would be better to try production nearer the "Doorstep of the World's Market" and control, to some extent, the sale of my own products. I therefore returned to England.

Enthusiasm but No Knowledge Being utterly ignorant of farming or fruit-growing, I sought the advice of a fruit-grower in Kent, and fortunately he was able to bring to my notice the farm which I now occupy. It covers some 250 acres and consists of chalky banks with hardly any level land at all. The farm had previously been a large nursery for flowers, shrubs, fruit trees, etc., which had failed. When I took it over the whole farm was foul and derelict, without a man or an implement on it, and had been spurned by several prospective tenants before I appeared. However, it commanded lovely views, it had a good house, and was near the railway station, so I took a lease of 21 years. Looking back, it seems to have been madness: at that time (1920), I was 37 years old, tubercular, had a young family and was entirely without farming experience and with no adviser to help me. On the credit side I had earned my own capital and had a good business training, adaptability, tenacity, and the love of an open-air life. More, I was determined to confound the critics who gave me six months in which to go broke.

In February, 1921, without the least idea of what I needed, I advertised for a working foreman, and ultimately engaged a man of over 50, ultra-conservative and a poor manager, although a good handyman. Together we attended sales and bought horses and implements at fabulous prices, engaged one or two men and made a nervous start. We planted 30 acres of potatoes, sowed barley, limewashed the fruit trees and pruned some of them, meanwhile gaining a little experience and losing much of my early confidence.

Of course, I lost money—for some time—but my health improved, largely, I think, because I had no time for introspection and was in the open air most of the day. Eventually I recovered entirely and have been perfectly fit now for many years, my wife and I raising a fine, healthy family of seven. Naturally I had many disappointments; but there were also some successes, and I have enjoyed a good income for several years, which has left a substantial margin.

Period of Trial and Error At first my methods were necessarily unorthodox, and doubtless to others amusing, but by trial and error I learned a lot, and gradually came to succeed beyond my early hopes. It was largely a matter of daily groping my way until I regained confidence. I consulted no books, for they would have muddled me anyway. The County Organizer was very good indeed, and very willingly offered advice when sought, but he was not near at hand and therefore seldom consulted. I had, however, a very successful and progressive neighbour, whose operations I watched and when I thought them likely to suit my conditions, copied them. I benefited considerably from his advice, which was generously given when he found that it was

applied and not wasted. Help from a nearby farmer whose conditions are similar is, in my view, of inestimable value to the beginner; indeed, co-operation goes a long way towards success.

I have tried almost every branch of farming, and it is a wonder I have not crashed. The first year saw the planting of several acres of soft fruit in wrong soil with the wrong aspect, and subsequently no labour for picking it! Ultimately it had to be grubbed. We grew lovely coloured apples and scores of varieties but no quantities. Although I peddled them by the dozen at the big London stores, they did not pay; I made several friends but no money. A few pigs for breeding petered out after a time, for I could not stand the pigman's constant refrain in the morning that "she has laid on another couple". Jersey cows for household milk were all right until I found the cost of the milk, due to "missing the bull," etc., too high to bear. Hereford cattle bought at Shrewsbury to fatten indoors during the winter was another experience gained but money lost, and last but not least, the maintenance of a flock of some 70 Border × Leicester ewes for the production of fat lambs and keeping tidy the hilly banks introduced me to the diversions of maggoting and also shearing when labour was wanted elsewhere, but little in the way of cash. All these have passed, without regrets, unless it be the absence of gambolling lambs in the spring.

And so the pilgrimage proceeded: hopes and disappointments, failures and successes; and the reader will wonder if, after all, this is not the conventional tale of the farmer living on his losses. I must disclose, therefore, how we have progressed and where we have arrived. I learned early that proverb "He who forgets or gets behind, pays"; I also discovered that intelligence does help to decide that sometimes "to-day is too soon and to-morrow is too late"; and that these facts cannot be learned from books. I also found that it was necessary for me to learn how to perform all jobs myself, before I could expect to have them done well by others. I also learned that the best insurance against failure was to be constantly on the holding, getting to know all conditions of labour, whatever the weather, finding out thereby the most economical way of getting the job done, setting the example, and meantime keeping labour "jogging". Only now and again were markets attended.

Now Cereals and Winter Vegetables

And so to present methods of cropping and marketing. In the early days we found fallowing expensive, and therefore we developed a system of cleaning crops such as potatoes, cabbage and cauliflowers, to avoid loss while bringing a field into heart again. This made a very considerable difference to our income; before the war we were growing about 30 acres of potatoes and 50 acres of vegetables such as cabbage and cauliflower, the remainder of the farm being occupied by wheat, oats and barley—mainly barley, because we can always grow a first-class sample—some seeds and lucerne, as well as a few acres of apples. Just prior to the war we had also developed a poultry plant which raised about 2,000 head a year, chiefly for the table (Rhode Island Reds × Light Sussex), but these have had to give way to war-time conditions, and I doubt if I shall reinstate them.

By slightly increasing our cleaning crops to about 100 acres, we are now able to plan our work so that the land gets a change and labour can be fully utilized during the winter and through the year. Potatoes and green vegetables provide work and income in the winter, and would be

greatly missed if relinquished, although a stranger to the farm might regard it as most unsuitable for such crops. The fact is we have been most successful with them; we often get crops of 10 tons of Majestic to the acre, and in 1943 averaged 13 tons sold per acre on an 18-acre very light field. Alexander's very late Savoy has done exceptionally well here on our banks, since with careful treatment it will stand through the winter longer than on better land and can be marketed when greenstuff is usually scarce in late spring. We had 36 acres under this crop in 1943, as well as some 20 acres of January King cabbage. We also grow 10 or 12 acres of autumn cabbage, which can be cut in time to follow with wheat and provide a job after harvest. By reason of the labour involved in repeated cutting over the same ground, we have given up growing cauliflower. Runner beans on sticks, of which we grow some 6 acres, provide a good proportion of our income, but it is a specialized job and requires a lot of labour for harvesting. We have also tried out small pieces with tomatoes, ridge cucumbers and corn cobs.

Mechanization For several years cultivations were done by one tractor and six horses, but it has now been found that horse labour under our conditions is very uneconomical, and by reason of lack of horsemen, difficult. We have now only two horses, which are seldom used, and three tractors—one on rubbers for transport and light work, and two caterpillars—which, together with a 4-furrow plough and a set of discs, get the work done much more efficiently. In fact, we could not cultivate some of our steep banks without the crawlers; by their help we now crop the whole of the land on the farm, bringing into profitable cultivation banks which were derelict for nearly 20 years. As far as labour is concerned we employ about a dozen men regularly throughout the year, augmented when possible, in the summer and autumn, by two or three local women and schoolboy or camp labour.

Straw trod for Manure I firmly believe in maintaining a credit balance in the soil, and to this end we have sought to ensure good crops by careful feeding. Before the war we bought some 1,000 to 1,500 tons of London stable manure every year, carting it from the nearby railway stations with horses in the winter, paying for it from the proceeds of straw sold for littering strawberries, instead of the usual method of turning it into dung ourselves. But now, since this is no longer possible, we have constructed a straw-walled stockyard in which we tread down as much straw as possible by feeding neighbours' cattle at a pre-arranged price. Then we mix all our own chemical manures according to the available supply and the needs of particular crops. These, of course, we augment when possible with unrationed organic manures; thus by careful manuring, ample cleaning cultivations, and suitable rotation, we are able to maintain a high standard of fertility and our crops compare more than favourably with those obtained from good average land.

As some indication of the results obtained here, I would say that for the past few years our annual average production covering all crops is about 1,000 tons, and that the financial reward has been adequate.

A Word to the Newcomer While the foregoing shows what can be done under very adverse conditions, it is not to be understood that I recommend my methods, for many a man without sufficient capital would have succumbed before the profits started to come in. I can say that after twenty years of a farming pilgrimage, often over rough roads, it has been a great game, and the joy of achievement

has been beyond all monetary reward. We have raised a fine healthy family, I have fully recovered my health, and I own a nice piece of the "Garden of England," although scarred somewhat by enemy action.

If I may tentatively offer advice to a prospective farmer in similar circumstances, I would say: spend at least a year working for a progressive farmer before making a personal venture. Get a good basic knowledge of the day-to-day problems which any farm will throw up, for without it stabilization cannot be achieved, nor can one's resources be planned to the best advantage.

GREEN PASTURES

VII. The Economics of Grassland Farming

W. A. Stewart with J. A. Scott Watson of Oxford University, and A. A. Copland of New Zealand, now farming in Somerset (B.B.C. Home Service. December 28, 1944)

THE final discussion in this series is noteworthy for the fact that Mr. Scott Watson and Mr. Copland have studied grassland problems both in this country and overseas. The former is familiar with American farming, the latter with farming in New Zealand, of which he is a native.

Grass in New Zealand and the United States

Asked as to the place of grass in New Zealand farming, Mr. Copland said that in the dairying areas grass grows even in the depth of winter; whether as pasture, hay or silage, it is the foundation of winter milk production. About 80 per cent. of all hand feeding is hay. Some farmers in the North Island can dispense with concentrates, but in other parts, in winter, they have to supplement with protein "from a bag".

Speaking of America, Mr. Scott Watson said that the best farming regions are arable rather than grass, with a hot, dry summer and a very severe winter. During drought periods farmers rely on lucerne and mixtures of lucerne with cocksfoot, or a brome grass. In winter they depend chiefly on maize silage and lucerne hay.

Mr. Stewart then inquired what sort of pastures, permanent or temporary, produced the meat and dairy products which poured into this country before the war. Mr. Copland replied that the best grazing areas in New Zealand are mostly 6- to 10-year leys liberally dressed with phosphates and lime. He has been much impressed by our Midland pastures, which have been farmed for generations by wise men who have not robbed them. He has, however, seen new pastures in this country on much inferior soil equally as good. Whether the bulk of these old pastures can be improved economically by ploughing up depends on circumstances. "On post-war policy," interpolated Mr. Stewart.

On the question of natural versus cultivated pastures, Mr. Scott Watson said that the Midland graziers had, by skilful management, preserved the really good species—ryegrass and white clover—but the biggest output per acre he thought would be found not in Leicestershire but on the leys in Northumberland under ley farming.

In reply to a question whether there are any pastures in the world where the cost of production is so low that the ley farmer could not compete, Mr. Scott Watson said that in America the opposite number of Leicestershire is the Blue Grass (smooth-stalked meadow-grass) country of Kentucky. It did not impress him greatly, however; he thought that the temporary seedings (including lucerne) were producing much larger outputs and creating fertility which was really being cashed. This also applies in the Argentine,

where the basis of production is not natural grassland but lucerne which is broken up from time to time and reseeded. While there is still a place on many farms for permanent grass, tillage land is more productive and generally more profitable.

"Store" Land Both Mr. Copland and Mr. Scott Watson emphasized that the basis of cheap meat production is a plentiful supply of well-grown cheap stores. In New Zealand there are extensive areas of "store" country, costing little in man-power, buildings, machinery and fences, and producing stock for finishing on the cultivated pastures lower down. In America there is extensive range in the West, too dry for cropping but cheap and suitable for rearing Herefords, with the result that there is always a good margin for the feeder in turning these stores into beef. Mr. Scott Watson further pointed out that we have here at home a good deal of natural store land devoted too exclusively to sheep. The western hills of Scotland and the Welsh hills formerly produced large numbers of store cattle, and by a higher standard of pasture management they could do so again without a reduction in our supply of lambs.

The first necessity, said Mr. Copland, is permanent fencing into blocks of reasonable size—200 acres upwards. "It seems to me," he added, "that the best way to benefit the hillman and the country would be to subsidize the fencing and not the ewe." He went on to say that it was the wisdom of the early settlers who divided up the backland, right up to the snow line, which was responsible for New Zealand's position as the premier producer of fat lambs. It seemed clear to Mr. Stewart that New Zealand, compared with this country, had developed its natural resources to better advantage and used ley farming as a means of increasing the supply of stores as well as just feeding them. Mr. Scott Watson thought there would still be the difficulty of wintering cattle in hill country; they would have to come down to the lowlands.

Copland: "Couldn't that be overcome by buildings?"

Stewart: "No, not altogether, but there is a good demand for the weaned calves from the low-ground farmers."

Ley Farming and Marginal Land After some reference to a new rearing enterprise in Glen Orchy, to a Jersey herd in another glen, and to the impossibility of ley farming without stores, Mr. Stewart switched the discussion back to the problem of the deterioration of our natural store country. This, he said, is a grassland problem, a problem of our marginal land. "Where do we draw the *margin* in regard to ley farming?"

Mr. Scott Watson said there were margins in two directions: (1) land too dry and hot for leys; (2) too high and steep and cold. Technically, most difficulties can be overcome by modern equipment and the use of the right grasses, but whether the work will pay is the point to consider. He had just been to a so-called marginal farm in Herefordshire, 500 to 800 ft. up, which before the war grew chiefly bracken and agrostis. It had been brought into a ley farming system; and it is now carrying double the former stocking and a large part of it is growing cash crops. When we have tractors, cheap phosphates and cheap lime, a great deal of what our ancestors called marginal land can be well farmed at a profit. Mr. Copland thought this kind of thing was well within the British farmer's capacity. Always assuming it pays, Mr. Stewart interjected. Mr. Scott Watson said it cannot be a pure question of economics. "It was shown to the Dutch that they couldn't reclaim the Zuyder Zee and make a 5 per cent. profit on the investment; they reclaimed the Zuyder Zee nevertheless."

Milk from Grass The discussion then turned from meat to milk, where water, buildings and other factors make the land equally suited to both. It was agreed that from the point of view of the most efficient conversion of grass as well as of the financial return the advantage lay with milk. It was possible, Copland repeated, to produce milk entirely from grass hay and silage. He was opposed to the use of nitrogen on grassland, except in special cases. "The interesting thing in America," said Mr. Scott Watson, "is what the milk producer can do with really high quality hay." Cows have given 1,000 and 1,200 gallons on just pasture in summer and high quality hay, with some grass silage in winter. The hay is cut young and handled in such a way that heating in the stack and damage to the leaf is avoided.

As to the relative merits of seeds hay and meadow hay for milk production, both Mr. Scott Watson and Mr. Copland favoured the former. If it were true that some farmers got more milk from meadow hay it must be, thought Mr. Scott Watson, because the seeds had been allowed to go beyond the proper stage for cutting.

Risks in Ley Farming The next question concerned the risks involved in ley farming. Mr. Copland regards ley farming as progress over the natural state, and all progress entails risk; but the good farmer is seldom caught.

While agreeing broadly, Mr. Scott Watson felt that there is a lot of risk in connexion with the establishment of leys on our more extreme soil types and in our drier areas—thin chalk, light sand and heavy clay. Early ploughing to get a good tilth, early seeding and drilling as deep as one dare, are all helpful. Tilth is also important for heavy land. Drought-resisting plants are particularly necessary for light land. Asked as to American practice, he said that the basis of their leys had to be something like lucerne and a smooth brome. Also, they had given up the idea of hard grazing. "Drought-resisting plants won't stand hard grazing; it weakens their root system and hence their drought-resisting power."

In New Zealand also, Mr. Copland remarked, lucerne can only be grazed periodically.

What about sainfoin? Mr. Scott Watson thought that some of the most interesting things being shown by Sir George Stapledon at Colesbourne are his lucerne-cocksfoot and sainfoin-cocksfoot mixtures.

Health and Nutrition Finally, the question of health and nutrition. Mr. Scott Watson said summer milk has a higher value than winter milk produced on hay, straw and cake, but grass silage helps to retain the nutritional value of milk during the whole year. Mr. Copland supported this view. As a result of reseeding, top-dressing with "super" and lime, butter-fat production in New Zealand had increased from 258 million pounds in 1928 to 409 million pounds in 1940. It was agreed all round that leys are healthier and less liable to parasitic infestation than old grass.

In conclusion, Mr. Stewart said that leys seem to be replacing permanent grass all over the world, and if 95 per cent. of New Zealand's wealth is derived from grass it seems a fair assumption that out own island could do much more to restore its wealth and vigour by the extension of ley farming.

It is understood that the series "Green Pastures" will shortly be published, as broadcast, by Messrs. Littlebury and Company Ltd., The Worcester Press, Worcester.—Editor.

CLUN FOREST SHEEP

T. Nellist Wilks

Bewdley, Worcs

CLUN FOREST sheep, although the most recent of our native breeds to be dignified by a Flock Book, have been known for their good qualities for over 100 years. The breed originated on the borders of Shropshire, Radnorshire and Montgomeryshire, and takes its name from the old South Shropshire town of Clun and its surrounding forest. At the beginning of the nineteenth century there were more than 12,000 acres of common lands and forests in this area—typical upland sheep run—to which the sheep had access.

With the object of securing purity of lineage and fixity of type, and to popularize the breed, the Clun Forest Sheep Breeders' Society was founded. A writer in the Journal of the Royal Agricultural Society, in 1892, said:

> "A well-bred Clun ram, as it now stands, is an imposing animal; one which demands admiration from all those who possess an eye for a sheep. The ewes are now eagerly bought at markets far from their original home. In the Clun Forest sheep there appears to be all the essentials necessary to produce a breed which cannot fail to add to the renown of a county which already occupies a leading place in the annals of sheep breeding."

Subsequent events, as the present writer hopes to show, have amply justified that estimate.

Various writers in the early nineteenth century referred to horned black-faced sheep and white-faced sheep without horns in the hills nearer Wales. This locality seems to point directly to the Clun area, and it seems to have been accepted that the Clun Forest sheep were originally white-faced and hornless. Subsequent development has tended towards a darker face, and to achieve this there has undoubtedly been much interbreeding. The enthusiasm of the early flockmasters would naturally lead to selection towards a definite type, retaining the best of the original characters, such as the high quality of both meat and wool.

Characteristics The Clun has a clean, open, dark brown face, and the top of the head is nicely covered with white wool; dark wool is undesirable. The ears are not too long and are carried high, giving the sheep an alert appearance. Great importance is attached to a strong shoulder, without coarseness, followed by a good spring of rib. This conformation gives rise to a full-bodied sheep with a capacity for foraging, for which the breed is noted. The hind legs are strong and set well apart, with good clean hocks, giving the sheep an excellent carriage. These hocks are set low down to allow room for a good second thigh, and a full leg of mutton. The fleece is fine and of first quality, set close to the skin, and of medium length. Clips are of good weight, ewes averaging 6 lb. and tegs 5 lb. of washed wool.

In size, the Clun is relatively large. Twin lambs have no difficulty in attaining 45 lb. dressed carcass weight at four months. Older lambs easily reach 55 lb., and wethers, carried on to the end of the year, reach 80 lb. The meat is of excellent quality and never too fat; in fact, lean fleshing is a definite characteristic of the breed.

The Clun sheep is a wonderful forager, and will look after itself wherever food can be found. At the same time it is not a restless animal, and is not difficult to contain provided it is given a sufficient change of pasture, thus conforming to the rules of good flock management. One of the breed's

most useful features is the small amount of individual attention required. Shepherding, therefore, is simple, always provided that the general management is good. Difficulties at lambing time are rare, due no doubt to the good conformation and neat proportions of the ewe, combined with ample pelvic room. The ewes are good mothers, not temperamental, and give an abundance of rich milk which ensures the lambs a good start in life, and fattens them with early, even fleshing.

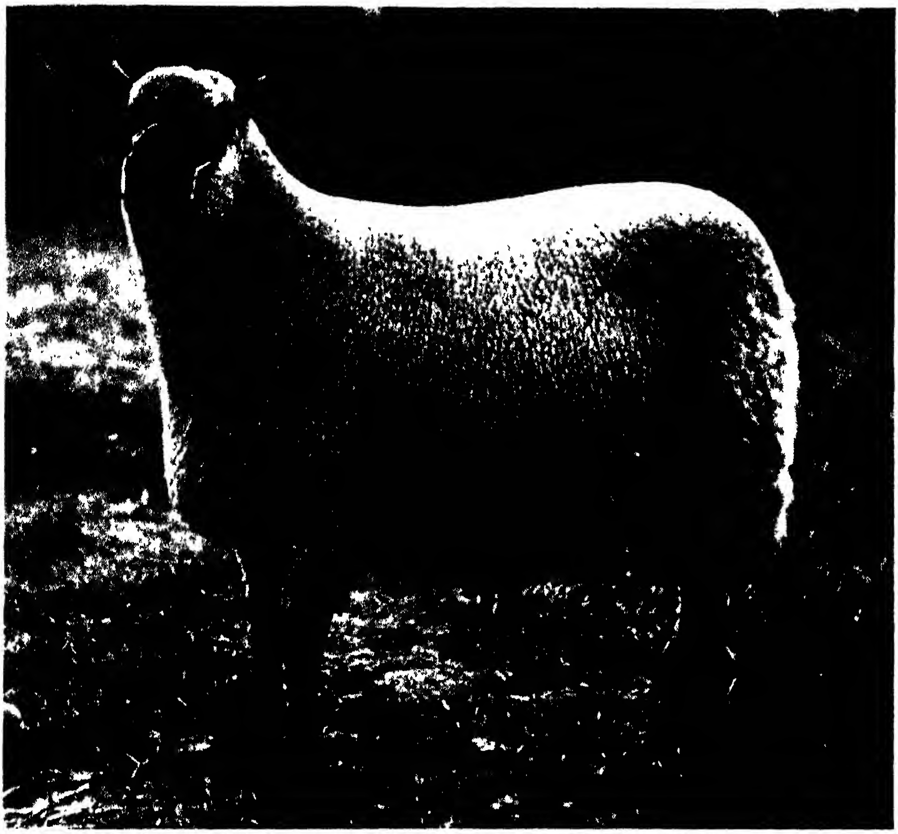
Fecundity High fecundity is desirable in any breed of sheep, and in the Clun it is a marked feature. Instances of as many as 175 lambs weaned per 100 ewes have frequently been recorded; an average of 150 is a reasonable expectation under good management. The lambing season can be elastic without detriment to results, and can depend entirely on the over-all requirements of the farming system practised. Thus if early fat lambs are needed, lambing can be arranged for February and is well within the capacity of the breed. Generally the period is from mid-March to mid-April.

Very little hand feeding is necessary, particularly where leys are available. An interesting and useful feature is the manner in which the ewe lambs will breed successfully and without detriment to their future well-being, provided, of course, that they are sufficiently well managed. Up to 60 per cent. will usually rear a lamb if mated late in October. Good feeding and management cannot be stressed too strongly if this practice is to be followed, but the sheep will prove equal to the task so long as it receives its due.

A General-Purpose Sheep The Clun has a wide range of usefulness and can truly be described as a general-purpose sheep. It is at home on the hills and moorlands, and will forage and fend for itself like a mountain breed. At the same time it is equally suited to more intensive management, and probably no sheep is better fitted to convert young leys into meat. Its response to this very nutritious feed is of a high order, the result being lean meat, not fat. Folding of ewes is undesirable—in fact, unnecessary—as the Clun will range evenly over moderate- or large-sized fields without attention. This character has been amply demonstrated in the southern parts of England, where the breed is finding increasing favour.

On the leys of the West Midlands it has established an enduring place, and is used as an orchard sheep in the same area. For root feeding, the wether lambs are much sought after, and feeders have found Clun sheep equal to the Down cross on the Clun, particularly for quick maturity. Farmers find it an advantage to be able to produce their own breeding sheep, for by using one breed only, they avoid the expense and trouble of buying in periodically.

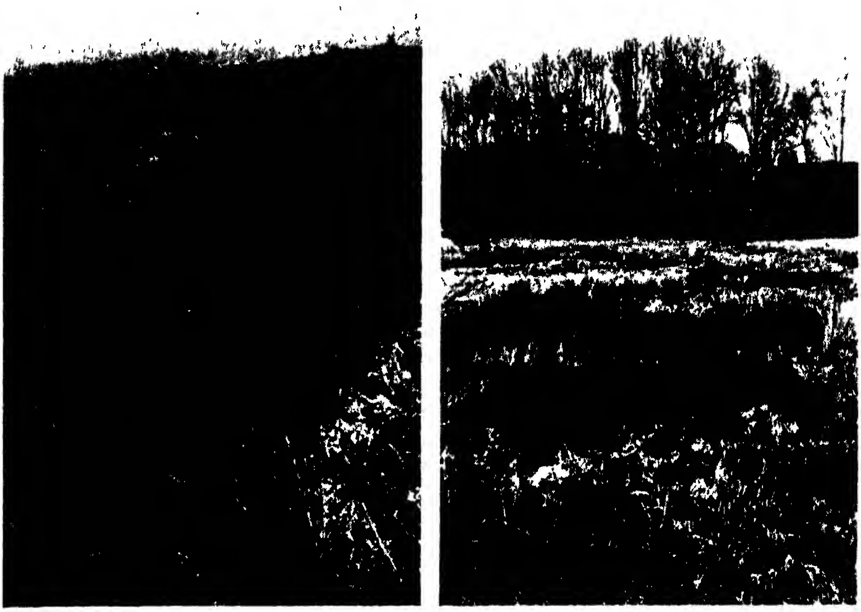
Distribution Originally a local breed, the Clun has invaded a good deal of "foreign" territory, as the number and location of flocks show. Between 1941 and 1943 there was an increase of 47 per cent. in the number of registered flocks, and the number is still mounting. Flocks are distributed over at least 16 counties of England and Wales (mostly in England), and range from Monmouth to Surrey and Hampshire. These figures refer only to flocks registered with the Flock Book Society, but a much greater number of flocks, kept pure but not registered, exist over a wider area, and these have even gone north of the Humber and into far western Devon. Such flocks are also crossed with a Down ram. Buyers at the autumn sales at Craven Arms, Knighton, and other centres, come



Top Clun Forest Ram, "Fields End O 14"—Second Prize Yearling and one of group of three which won the Sir Jeremiah Coleman Challenge Cup. Sold for 155 guineas, September, 1944
(Photo by G. W. Alderson.

Bottom. Clun Forest Yearling Ewes. *Photo: Sport & General.*

IMPROVEMENT OF SUSSEX MARSHES BY RESEEDING (See pp. 499-501)



Before . . .

The type of rough land at Amberley before reseeding. Note the earlier reseeded area in the background of the left-hand photograph.

and After . . .

The result of reseeding in 1941 with the timothy-cocksfoot-white clover mixture.

from all over England, and the numbers of Clun ewes changing hands amount to over 30,000. There seems no doubt that the popularity of the Clun ewe is due, in large measure, to her adaptability, and she has been a popular choice for crossing purposes for a great number of years.

Future of the Breed It is sometimes stated that the British Isles has too many breeds of live stock. This is open to argument, but it is incontestable that as far as sheep breeds are concerned the Clun can justly claim a prominent place amongst them. It meets the modern demand for a general-purpose breed and for one which will fit into all circumstances as they arise. It is capable of adapting itself to various systems of management. For the greatly increased use of leys in their many forms, and the type of farming associated with them, a sheep such as the Clun is ideally suited.

The fact that it fits in with the less intensive methods of shepherding is very important, when the most has to be made of every man's time.

Breed type has been established successfully, and it is satisfying to watch the growing uniformity displayed at the breed sales. Ruthless culling of undesirable features has paid the breeders handsomely, and rams which have proved their value as getters of the right type are much sought after, indicating that Clun Forest breeders know what they want and how to get it.

IMPROVEMENT OF SUSSEX MARSHES BY RESEEDING

I. V. Hunt, M.Sc.
Chester

An extremely interesting case of reseeding was undertaken on the Amberley Brooks, Sussex, during 1941, under exceptionally difficult mechanical conditions, and the results obtained over a period of three to four years should prove both enlightening and encouraging to owners of similar brooks. These brooks, which are in places no more than a thick mat of turf on top of quaking peat, were reclaimed without drainage, without ploughing, without phosphates and without the use of pedigree grasses or clovers. The results were satisfactory, although doubtless they would have been better if the above had been available. Nevertheless the experience gained indicates how, in their absence, reclamation can be effective.

Before 1941 this land carried only a little rough grazing, although it had at one time been extremely productive for bullock fattening. After years of neglect the herbage had reverted to rush, sedge, tussockgrass, sheep sorrel and meadow buttercup. Soil analysis indicated a considerable lime shortage, very little phosphate, but adequate potash. Considerable differences were evident in the soil analysis results taken at from 3 to 6 inches deep when compared with those taken from 0 to 3 inches deep. Typical results were :

Soil Analysis Results

Sample	Texture	*p*H	Lime Requirement		Available Potash	Available Phosphate
inches			*tons*	*cwt.*		
A. 0–3	Peat	4.2	5	12	Very high	Very low
3–6	Peat	3.9	6	10	Low	Very low
B. 0–3	Peat	5.0	3	10	Very high	Medium

The brook represented by Sample B was reclaimed in 1941, and that by Sample A in 1942. From a mechanical point of view the prospects were not too good. The surface was extremely uneven, some of the hummocks being 1½–2 ft. high. Within 4–6 in. of the surface the peat was soft and incapable of bearing a heavy implement; no effort was required to drive a 4–6 in. diameter post 10–15 ft. deep into the peat with the hands alone, and the wheeled tractor available for the job was unable to plough sufficient depth to bury the tussocks without becoming hopelessly bogged.

Taking into consideration this mechanical difficulty and the results of the soil analysis, it was decided to carry out all necessary cultivations without ploughing and retain on the surface as far as possible the relatively rich top soil. During April, 1941, the brook was thoroughly disced, harrowed with a ripper harrow, and cultivated with a spring-tine cultivator. A tilth was produced, but a stage was soon reached where further disintegration of the tussocks was impossible. These were collected and about three hundred cartloads carried off the five-acre field. The results were good enough to make the field eligible for the ploughing-up grant. Two tons of agricultural lime were applied per acre, and although an application of phosphate would have been desirable, none was available. A simple seeds mixture was sown consisting of:

(A)

lb. per acre	
8	American timothy
8	American cocksfoot
2	American alsike and white clover
18	TOTAL

The original intention was to sow with an Aberystwyth timothy but it was unobtainable, the only available substitute being the American timothy. Sowing took place at the end of April, and about a month later the whole area was flooded about a foot deep. One small area was covered for over a week, and many young grass and clover seedlings were killed—and the land was quickly invaded by rushes and buttercups.

A late hay cut taken on this field yielded heavily and more than paid for the cost of reclamation. Ample sweet grazing was available from the aftermath up to the end of November. The surface of this brook was excellent and did not suffer any obvious damage by the autumn grazing. Rain quickly soaked through the turf leaving a dry, firm footing for stock.

During 1942 and 1943 the brook was grazed, and although by 1943 the clovers had practically disappeared (and possibly for this reason the grazing was not quite as rich in protein as it might have been), there is no doubt whatever that the grazing was palatable. The main difficulty was to keep stock off the brook to give it the necessary occasional rest.

The results in 1941 were so satisfactory that a further series of brooks was tackled, but this time more orthodox and costlier methods were used. The brooks were mown and ploughed during the latter part of April, 1942, two tractors being employed, one to pull out when the other became bogged. After preparation of the seedbed the land was dressed in the first week of May with 2 tons per acre agricultural lime and 5 cwt. per acre basic slag.

The seeds mixtures used were of two distinct types: one (B) provided by the Grassland Improvement Station, Dodwell, under the Royal Agricultural Society of England Direct Reseeding Demonstration Scheme, and the other (C) of the same type but cheaper.

(B)

lb. per acre	
10	Irish Italian ryegrass
20	Aberystwyth S.24 perennial ryegrass
2	American timothy
4	Aberystwyth S.48 timothy
1	Early broad red clover
2	Aberystwyth S.123 late-flowering red clover
$\frac{1}{4}$	Wild white clover
$\frac{3}{4}$	New Zealand certified permanent pasture white clover
1	Trefoil clover
41	TOTAL

(C)

lb. per acre	
10	Irish Italian ryegrass
12	Irish perennial ryegrass
6	Kent indigenous perennial ryegrass
6	Scotch timothy
2	English late-flowering red clover
1	Alsike clover
$\frac{3}{4}$	New Zealand certified permanent pasture white clover
$\frac{1}{4}$	New Zealand certified mother strain white clover
38	TOTAL

Conditions after sowing were not at all favourable to success. The peat dried to a dust to a depth of 3–4 in., the few grasses that germinated withered away and until August, the only plant growth consisted of sheep sorrel. Thick mats of it grew all over the sown area.

Fortunately for our purpose August was wet and the dormant seeds grew away rapidly. The rain, however, introduced another difficulty: owing to the extreme dryness of the peat, the water remained on the surface, making it impossible to graze without hopelessly puddling the surface. A silage cut was taken and stock turned out to graze in the autumn, but the surface did not lend itself to grazing and became pitted with deep hoof marks. The following spring (1943) the brooks were flocded to a depth of one foot for four weeks without any obvious harm. These brooks were grazed throughout 1943 and provided plenty of well-balanced clover/grass herbage. Hardly any sorrel was to be found during 1943 in spite of the considerable growth during the previous year. This disappearance followed a severe killing of the sorrel shoots during continuous hard frosts in the winter of 1942–43.

This difference in surface between the 1941 and 1942 brooks is attributed to discing and ploughing respectively. In discing, the structure of the soil was preserved and drainage was normal. In ploughing, an impermeable layer of rush and sedge shoots was interposed between the subsoil and the sown seed. The latter were cut off from all normal soil moisture and during the dry summer the seedbed became "unwettable". Later during the August rains, water accumulated on this dry surface and would not soak through; indeed it was possible to take up handfuls of perfectly dry soil from the bed of these pools of rain water.

It is realized that neither of the above reseeding experiments gave complete satisfaction but a combination of the two, that is discing, no ploughing and the use of a good seeds mixture, would give ideal results, although the absence of one or the other in no way means that improvement is impossible.

Briefly, the practical conclusions which seem to be indicated are:

(a) Discing gives a better grazing and mowing surface on peat bogs than ploughing.

(b) Improvement can take place in the absence of phosphate, but to secure a stand of clover it is essential to use basic slag.

(c) Established seeds can withstand temporary flooding.

QUALITY IN CEREAL-LEGUME SILAGE

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and
J. S. WILLCOX, B.Sc., A.R.I.C.
University of Leeds

FOR many years now cereal-legume mixtures have formed the backbone of silage production in this country. There are certain very good reasons for this, the principal being: (a) the comparative regularity with which reasonable yields are obtained in most seasons and over a wide range of soils; (b) the fact that the crop is harvested in July, thus allowing time during the hottest and driest part of the year for a bastard fallow. The latter point is of vital importance when the silage mixture is to replace roots, as it frequently does on heavy, difficult land, where the cost of growing roots is prohibitive and the crop obtained is so frequently disappointing.

Unfortunately all too frequently the silage, on analysis, is disappointingly low in protein and therefore ranks as medium- or low-protein material, having less than 15 per cent. of crude protein in its dry matter. Often it is suitable only as a hay and root replacement. On the other hand, it is possible to produce high-protein cereal-legume silage, as is shown by figures obtained during the 1943–44 silage campaign from samples of silage made in Yorkshire and analysed at the University of Leeds. During the 1944 season 42 cereal-legume samples were examined at Leeds. These had a range of crude protein content of from 6.4 to 21.4 per cent. of the dry matter, and of these 5 samples (i.e., 11.9 per cent. of the total number of samples) had more than 15 per cent. of crude protein in the dry matter, and could therefore be classed as high-protein silages suitable for production purposes.

In spite of the claims of grass, seeds mixtures and kale, as crops to be ensiled for the production of protein-rich silage, the advantages of the cereal-legume mixture, instanced above, are so considerable that it is likely to continue to be grown extensively. More especially will this be so if it can confidently be stated that under prescribed conditions there is a reasonable certainty of producing high-protein silage, and that the labour involved in the ensiling process can be reduced by mechanization.

The following account of work carried out during the 1944 season indicates the possibility of solving the first half of the problem.

The protein content of the silage would seem to be dependent primarily upon two factors: (a) the constitution of the mixture as between cereal and legume; and (b) the stage of maturity of the crop when cut for ensiling. Both these points were investigated.

1944 Trial A uniform field of heavy loam was selected for the trial, and the following crops were sown in half-acre plots in March, 1944.

			Stones per acre	
1.	Maple Peas		16	
2.	Spring Beans		14	
3.	Oats		16	(Potato 8 st., Black Tartarian 8 st.)
4.	Tares		12	
5.	Oats		12	
	Tares		4	
6.	Oats		12	
	Maple Peas		4	
7.	Oats		12	
	Maple Peas		2	
	Tares		2	
8.	Mixed Corn	Wheat	5	
		Barley	5	
		Oats	5	

TABLE 1

Date of Cutting	Plot Number	1	2	3	4	5	6	7	8
	Crop	Peas	Beans	Oats	Tares	Oats and Tares	Oats and Peas	Oats Peas Tares	Mixed Corn
June 8	Yield of Green Crop cwt./acre	115.5	75.42	..	117.85	123.57	141.92	145.25	162.64
	% Dry Matter	10.37	9.41	..	11.33	12.04	11.65	14.54	11.43
	% Crude Protein in Dry Matter	31.64	29.72	..	34.16	19.78	18.83	18.38	20.65
	Yield Crude Protein cwt./acre	3.79	2.11	..	4.56	3.14	3.11	3.88	3.83
June 26	Yield of Green Crop cwt./acre	241.98	165.00	347.0	268.71	280.5	360.64	353.57	304.07
	% Dry Matter	9.33	9.44	12.02	7.67	12.38	12.47	10.28	13.66
	% Crude Protein in Dry Matter	21.24	21.60	10.93	27.82	9.95	10.12	11.52	9.54
	Yield of Crude Protein cwt./acre	4.79	3.36	4.54	5.73	3.45	4.54	4.18	3.96
July 8	Yield of Green Crop cwt./acre	205.07	129.64	240.42	165.00	275.78	273.42	247.50	221.57
	% Dry Matter	12.05	12.69	18.23	12.38	18.06	17.84	17.35	19.79
	% Crude Protein in Dry Matter	18.70	20.90	9.16	26.41	9.40	10.79	10.26	8.83
	Yield of Crude Protein cwt./acre	4.62	3.43	4.01	5.39	4.68	5.26	4.40	3.87
July 20	Yield of Green Crop cwt./acre	190.92	117.85	200.35	153.21	202.71	231.0	207.42	200.35
	% Dry Matter	14.49	18.52	25.38	17.73	26.95	26.07	23.80	26.16
	% Crude Protein in Dry Matter	17.08	12.24	7.35	19.14	6.69	8.17	7.92	6.39
	Yield of Crude Protein cwt./acre	4.72	2.67	3.73	5.19	3.85	4.92	3.91	3.34

In order to obtain a measure of the variation in quality of the crop with advancing growth, the plots were sampled and cut at intervals as the season progressed. Samples for determination of yield per acre and for feedingstuffs analysis were taken on June 8 and 26, before flowering had commenced, on July 8, at the flowering stage, and on July 20, after flowering, when the oats were at the milky stage. One-third of each plot was cut for ensiling on June 26, July 8, and July 20. To determine the yield per acre on these dates 5-ft. lengths of swath from five points in each area were weighed immediately after cutting, and it was from this material that the samples for analysis were taken.

The yields of crop, dry matter content, crude protein content of the dry matter and yields of crude protein per acre for each plot on each of the four dates are given in Table 1 (p. 503).

Discussion The most striking result which emerges is the very definite deterioration in the crude protein content of the dry matter of all the crops which occurs with advancing age. This is brought out most clearly in Fig. 1 (p. 505) which shows diagrammatically the percentage crude protein content of the dry matter of all the crops on the four occasions on which samples were taken. This diminution in protein content is to some extent offset by increasing yield of dry matter as the crop gets older and growth proceeds. There is, however, a critical stage of growth beyond which increasing yield does not compensate for diminution in protein content, and this is evident from the figures for yield of crude protein per acre in the Table and from their diagrammatic representation in Fig. 2 (p. 506) which shows the yields of crude protein on the four dates when samples were taken.

With peas, oats, and tares, the maximum yield of crude protein per acre was obtained on June 26, when the plants were in the pre-flowering stage. Beans and the oats-legume mixture gave their maximum yields of crude protein on July 8 at the flowering stage; by July 20 the crude protein yield had diminished.

It is noteworthy that on July 20 the cereal-legume mixtures were at a stage of maturity which would be considered in practice to be suitable for cutting for silage-making; the oats were at the milky stage and the peas and tares well podded. The figures indicate definitely that this stage is too late and that a lower yield of crude protein results than would be the case had the crop been cut some twelve days earlier.

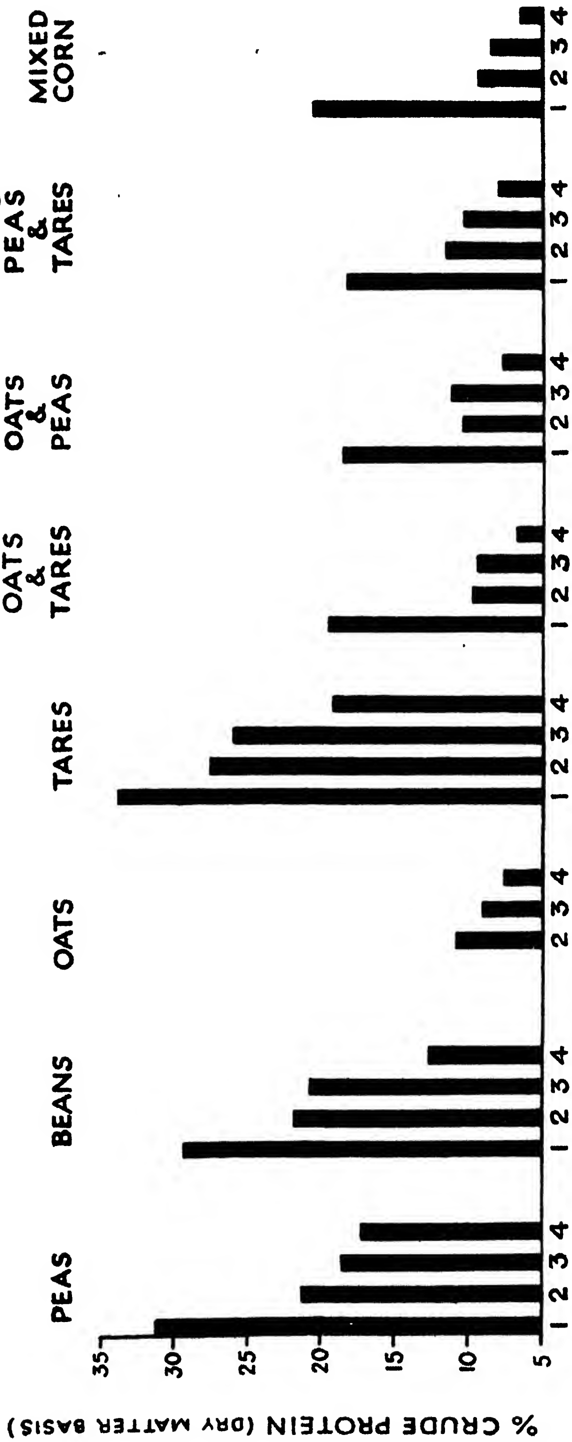
A study of the Table and diagrams also shows the high protein value of the leguminous crops, and it is evident that in a cereal-legume mixture the protein value of the silage will depend in large measure upon the proportion of legume present. Moreover, the disparity in crude protein content between cereal and legume appears to increase with advancing age and maturity. This is evident from Fig. 1 and from Table 2 below, which compares the crude protein content of the dry matter of mixed cereals with that of tares on the four dates concerned:

Table 2

	Mixed Corn *per cent.*	Tares *per cent.*
June 8	20.65	34.16
June 26	9.54	27.82
July 8	8.83	26.41
July 20	6.39	19.14

Careful consideration should therefore be given to the composition of the mixture sown, and the soil and manurial conditions should be such as will favour the legume, since in practice the cereal can be left to look after itself.

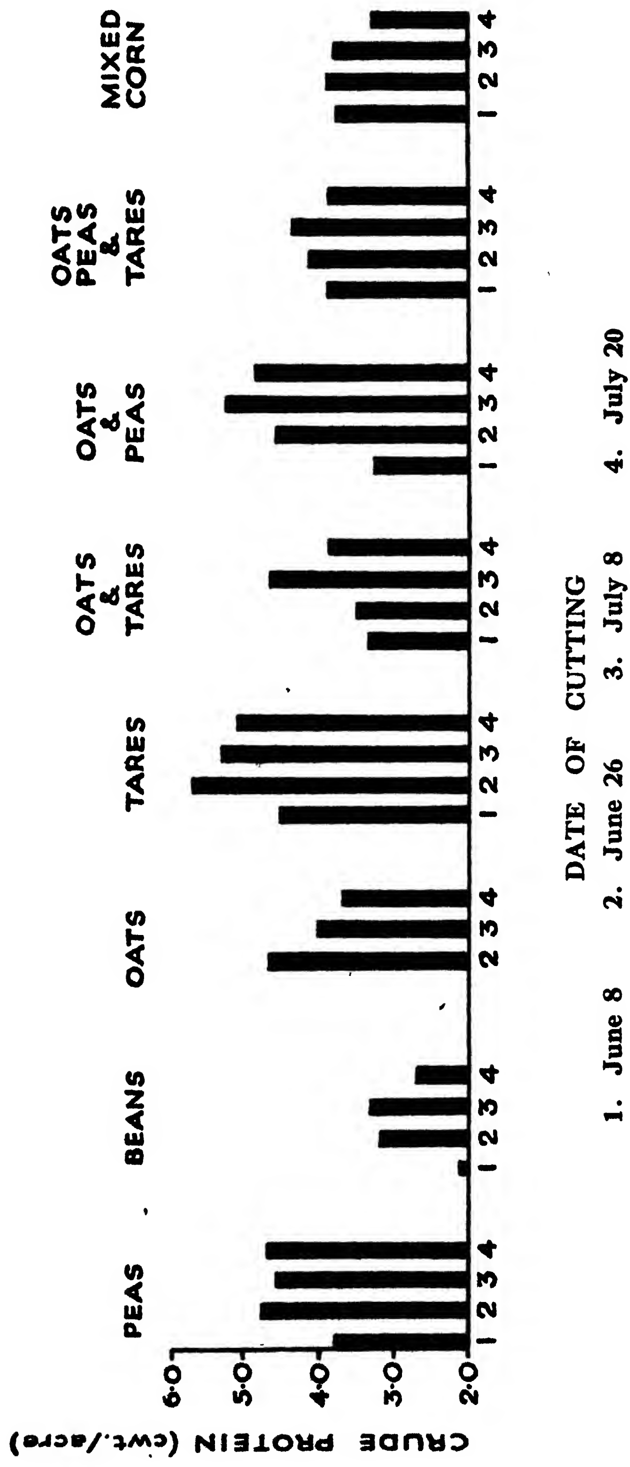
Figure 1



DATE OF CUTTING

1. June 8 2. June 26 3. July 8 4. July 20

Figure 2


PEAS
BEANS
OATS
TARES
OATS & TARES
OATS & PEAS
OATS PEAS & TARES
MIXED CORN
CRUDE PROTEIN (cwt./acre)
2·0
3·0
4·0
5·0
6·0
1 2 3 4
DATE OF CUTTING
1. June 8
2. June 26
3. July 8
4. July 20

The high-protein figures obtained for tares are noteworthy, and it is evident that this plant should figure largely in any mixture for silage-making.

Summary 1. For maximum production of protein per acre in a silage mixture of cereals and legumes, the crop should be cut at the flower-emergence stage.

2. The protein content of the silage will be influenced not only by the time of cutting but also by the content of legume in the mixture.

3. Tares have given consistently high figures for protein and have not fallen off so sharply in protein content with advancing age as the other crops.

It is realized that these results are from one trial only conducted during one season, but the figures obtained seem to merit the consideration of farmers at a time such as the present when the problem of supplying stock with adequate amounts of protein from home-grown crops is of the utmost importance. The trial is to be repeated on similar lines during the coming season at three centres in Yorkshire.

POTATO WASTAGE IN CLAMPS

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Agricultural Research Council

A VERY large tonnage of potatoes is lost in clamp storage in this country every year, the amount varying considerably from season to season. Losses are always above the average after a wet autumn and are thus likely to be high this year. The main cause of wastage this season will undoubtedly be Potato Blight, but often it is not realized what a large tonnage is lost annually from other causes. Indeed, there appear to be so many misconceptions prevalent with regard to the various forms of wastage, their relative importance and methods of prevention, that a brief review of the position may be useful.

The figure on p. 508 presents the problem of wastage diagrammatically. The major causes of loss are printed in capitals; those less important, in smaller type. The differentiation into these two categories is based on a wide viewpoint and must not be interpreted as meaning that the minor causes cannot give rise to losses as high as 100 per cent. in some instances. No attempt will be made to describe individual diseases of stored potatoes, as these are adequately covered by the Ministry of Agriculture's leaflets*.

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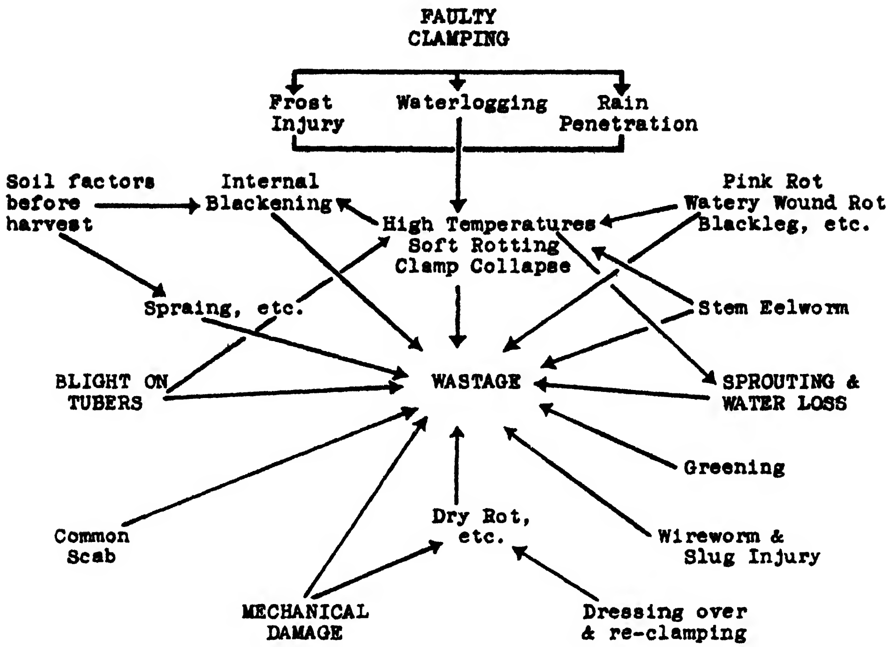
* Advisory Leaflets Nos. 5 (Common Scab), 107 (Black Leg), 178 (Stem and Bulb Eelworm), 218 (Dry Rot), 290 (Spraing, Internal Rust Spot and Net Necrosis), 292 (Pink Rot and Watery Wound Rot), and Growmore Leaflet 63 (Blight), obtainable free and post free from Berri Court Hotel, St. Annes, Lytham St. Annes, Lancs.



Faults in Clamping There is no doubt that a considerable amount of wastage results from faulty construction of clamps. Methods of clamp construction vary widely in different districts and have obviously been developed to suit local conditions. It would, therefore, be hazardous to lay down a standard design as being best for all parts of the country. Certainly some forms of clamping would be disastrous if practised in an unsuitable locality ; for example, the sunken clamps of Lancashire would lead to serious losses if used in the Lincolnshire fens. Apart from this variation in design, however, certain faults in construction are met with often enough to show that the principles of good clamping are not always understood.

The main function of the soil casing is to break the force of the wind, and that of the straw casing to provide insulation against frost and to stop penetration of water. Both casings should be of adequate thickness to fulfil their respective purposes. If harvest is late it should be remembered that the mere covering of tubers with straw does not protect them against frost or rain penetration should there be much wind. To throw off rain adequately, the angle of the walls should not fall below 45 degrees. The ridge, whether covered with soil or not, should be formed compactly of straight straw, laid crosswise, to give a good water throw down the sides. Ridge straw, if placed lengthwise directly on the tubers, acts merely as a rain-trap. The soil casing should be left with a slightly rough surface ; consolidation with the back of a spade gives a good finish but very often results in cracking during frost. The clamp site should be well drained and, if necessary, should be provided with drainage ditches. The inclusion of two or more varieties, separated by straw partitions, in a single clamp, is not a good practice, as it is very difficult to obtain sufficient vertical consolidation of the partitions ; this results in subsequent sagging of the ridge at these points and consequent rain penetration.

Clamp Collapse Rain penetration, frost injury or the inclusion of too many blighted tubers in a clamp, may all lead eventually to collapse of the clamp in whole or in part. In each case, after the initial stages, the course of events is roughly the same. Tubers injured by frost, waterlogging or Blight soon become a prey to bacterial rots. The process of rotting causes a rise in temperature and an increase in the carbon dioxide content of the atmosphere in the clamp. These conditions cause changes in the sound tubers surrounding the original seat of trouble, and may, in turn, lead to their becoming affected with soft rots. In this event the temperature rises higher and the destruction spreads, so that eventually extensive areas may suffer total collapse. Considerable heat may develop during the process ; temperatures of over 50° C. (112° F.) have been recorded. A secondary effect is that, beyond the area of obvious damage, the heat greatly accelerates sprouting and general loss of weight through evaporation and may, in addition, cause internal blackening of the tubers.

Usually it is not until spring, when the weather becomes warmer, that areas of collapse begin to show in clamps, but it should be remembered that collapse is the *end* of a process of overheating and spread of bacterial rots which has been going on inside the clamp for some time before anything becomes visible on the outside. If the beginning of such overheating could be observed by the use of a clamp thermometer,* it should be possible greatly to minimize losses by giving immediate ventilation, which would check the rise in temperature. This would be followed, when necessary, by early dressing over and disposal of the stock. Unfortunately at the present time insufficient information is available about clamp temperatures to make it possible to give useful danger-point figures. A detailed study of the temperatures of normal clamps and of clamps known to be wet or to contain a high proportion of blighted tubers would be of much value. In a year such as the present, when so many clamps have, of necessity, had to be built with tubers not in the best condition, the intelligent use of clamp thermometers might save much unnecessary wastage. Such instruments appear to have been used in Germany for a number of years.

Blight There is no doubt that Blight is by far the most important cause of direct wastage and that in some seasons it is responsible for enormous losses. There are three ways in which blighted tubers become included in clamps.

(1) Very often obviously diseased tubers that have become infected in the soil are picked up and thrown in with the sound ones. Sometimes quite a high proportion of blighted tubers are put into clamps in this way—sufficient even to start the processes leading to clamp collapse. When there is an appreciable number of blighted tubers at lifting time it would be worth assigning special pickers to pick out the "blights," which should be kept separate and boiled or steamed for stock feeding as soon as possible. Not only are they then saved from rotting, but the sound tubers placed in the clamps are in much less danger of spoiling.

(2) Where tubers have become infected in the soil, a proportion may, in some seasons, show no obvious signs of the disease and is therefore unavoidably included in the clamp.

(3) The third and most serious way in which Blight gains entrance to clamps is where crops are lifted with the disease still active on the green

* The clamp thermometer used in our experimental work is of the vapour pressure dial type, and is provided with a steel stem some 4 ft. long, pointed at the end and graduated every 6 in. to ensure insertion to the correct depth. The thermometer can be driven downwards from the ridge without difficulty.

haulm. A high proportion of tubers which were sound at lifting time may then become infected and rot during storage. Not infrequently serious tuber infection has been found to occur when the amount of infection of the foliage has been so small as to have been overlooked by the grower. The most satisfactory way of guarding against this form of infection is to burn off the haulm not less than ten days before lifting, though it is possible to take certain other steps to prevent it—all of which have been given wide publicity in recent years.

Whether the inclusion of blighted tubers in clamps leads to collapse or not depends on many factors. There is no evidence that the disease spreads in the clamp from diseased tubers to neighbouring sound ones. Small pockets of rotten tubers seem more often to result from localized areas of overheating, initiated by the decay of a few blighted tubers, followed by the spread of soft rots. Whenever 25 per cent., or often less, of the tubers in a clamp are blighted, there is great danger of overheating and total collapse, although much depends on the amount of moisture within the clamp. In dry clamps blighted tubers may not become the prey of soft rotting bacteria, and may shrivel up with an almost corky appearance—the result of destruction by the Blight fungus alone.

Sprouting and Water Loss Sprouting, water loss and respirational losses are responsible for the greatest reduction of weight in stored potatoes, especially under war-time conditions when stocks have to be held much later than is the normal practice. When such losses have proceeded so far that the tubers shrivel, whole stocks may be rendered unsaleable for human consumption. These forms of loss are almost negligible in winter, but gradually increase from March onwards, the rate depending greatly on variety and season. With some varieties stored in clamps where no additional ventilation is provided in spring, sprouting alone can be responsible for up to 7 per cent. loss of weight by May, and evaporation for a further 10 per cent. or more. Apart from varietal differences, sprouting is influenced largely by temperature; thus if overheating occurs sprouting is greatly increased for some distance around the affected area.

The somewhat scanty evidence at present available suggests that spring ventilation of clamps reduces sprouting, but that the gain may be more than offset by the greatly increased losses due to evaporation caused by the rapid circulation of air among the tubers. That such losses may be substantial is seen from the figures obtained in an experiment with two clamps of Majestic, from one of which the soil casing was completely removed in March, the other being left earthed up as a control. Three months later the loss attributable to evaporation was 17.8 per cent. in the de-soiled clamp and 6.7 per cent. only in the soiled control. The question whether or not the soil casing should be partially or completely removed in spring thus needs further examination.

It should, of course, be borne in mind that de-soiling may be the means of preventing very serious loss if the internal temperature of the clamp shows signs of rising too high, so that there is danger of collapse. It is merely the value of this method as a routine measure that is open to question. The best methods of minimizing losses due to sprouting and evaporation are: (1) the selection of varieties of slow sprouting propensity for long keeping; (2) the prevention of undue rises in clamp temperature, preferably by clamping only sound and dry potatoes, but, if there is any indication of high temperatures developing, by removing the soil from the ridge and from a strip along the base at the sides.

Mechanical Damage One of the most prevalent sources of wastage is mechanical damage. This may, on its own account, cause very considerable loss—admittedly not complete, as the tubers can be used for factory processing or stock feed, but nevertheless serious. A certain amount of mechanical damage appears to be unavoidable in a bulky crop, such as potatoes, but it is often unnecessarily increased by: (1) faulty setting of the spinner; (2) careless manipulation while clamping, particularly when semi-skilled labour has to use loading forks, the tines of which are worn sharp, or, in the case of the band-edged type where the edge is worn sharp; (3) careless manipulation when dressing. The effects of mechanical damage are not only direct; the organisms of the Dry Rot group of fungi are mainly wound parasites, and if the variety is a susceptible one, readily gains entrance in this way.

Dry Rot Rots of this type, caused by certain fungi of the genus *Fusarium*, are true storage rots in that infection occurs after lifting of the tubers. Losses in susceptible varieties such as Doon Star, Majestic and Redskin may reach considerable proportions, particularly late in the storage season. Much can be done to check such loss by careful handling and the avoidance of all forms of mechanical damage. Harrowings should always be clamped separately or disposed of immediately, since such tubers are particularly prone to attack owing to the rough handling they have received. Dressing over and re-clamping is very undesirable with varieties susceptible to Dry Rot. If unavoidable, the second period of storage should be as brief as possible. Damage sustained by the tubers in passing over the riddle is quite sufficient to permit the entry of the parasitic organisms causing Dry Rot.

Other Forms of Wastage One of the most striking points in any survey of wastage in potato clamps is the number of different causes that may produce serious wastage. Those dealt with above are the ones most frequently met with and which may be counted as the main source of loss. Not infrequently, however, clamps are seen in which very high losses have been produced by causes as diverse as the following:

Soil Factors before Harvest. Some evidence points to mineral deficiencies (e.g., potash deficiency) as being the cause of various types of internal blackening in potatoes both before and after cooking. In dry seasons especially, flesh markings of the types known as Internal Rust Spot and Spraing are formed in certain varieties, mainly on gravelly and sandy soils. These internal discolorations are a very insidious form of wastage in that where even a relatively low percentage of tubers is affected, the consignment is useless for human consumption owing to the impossibility of dressing out a sound sample. The nature of many of these non-parasitic tuber discolorations is still very imperfectly known.

Pink Rot, Watery Wound Rot and Blackleg are diseases which may cause considerable losses in individual instances, but which are fortunately not widespread.

Common Scab may be so severe that stocks fail to pass the ware standard and are consigned for factory processing or stock feed. Secondary rots do not usually follow this disease, so that the loss is never total.

Greening is not a serious form of wastage, but is occasionally responsible for the rejection of a fair proportion of ware tubers. This occurs mainly when crops have been imperfectly earthed up or where they are very heavy as on some silt lands in Lincolnshire.

Slug and Wireworm Injury may cause very considerable losses; the latter especially has been particularly prevalent during the war as a result of the cropping of ploughed-up grassland. The same remarks apply as for Common Scab injury.

Stem or Tuber Eelworm causes extensive cracking and cankering of the tubers, which may be followed by secondary fungal and bacterial rots in clamps. Heavy infections have been known to result in overheating and collapse of clamps. Fortunately the distribution of this soil pest is relatively restricted at present. No infected stocks should be used for seed, and the rotation should be planned with care. It should be noted that the lesions on the affected tubers, in the early stages at least, resemble those of Blight.

Four Important Precautions It will be obvious from this brief review of the main factors causing wastage in clamped potatoes that much can be done to prevent the most serious forms of loss. The most important measures to take are: (1) to ensure that blighted tubers are not included in the clamps, both by taking the necessary precautions to prevent sound tubers becoming contaminated with Blight spores at lifting time, and by direct discarding of obviously blighted tubers as far as practicable at the time of building the clamp; (2) to do everything possible to ensure that the tubers are sufficiently protected against frost and heavy rain before the clamps are earthed up, using, if necessary, fresh, dry straw at the time of earthing up, so that the tubers are kept as dry as possible; (3) to build the clamps carefully to ensure the exclusion of rain and frost during the winter; and (4) to keep an eye on the condition of the clamps in spring, so that if there is any sign that overheating and collapse are developing, strips can at once be de-soiled to permit cooling. This last measure will be particularly important in the coming spring, for owing to the adverse weather conditions last autumn, many clamps are likely to contain a high proportion of blighted tubers and to be wet enough to permit the development of soft rots and overheating as soon as the weather becomes warmer.

LEAF SPOT OF OATS

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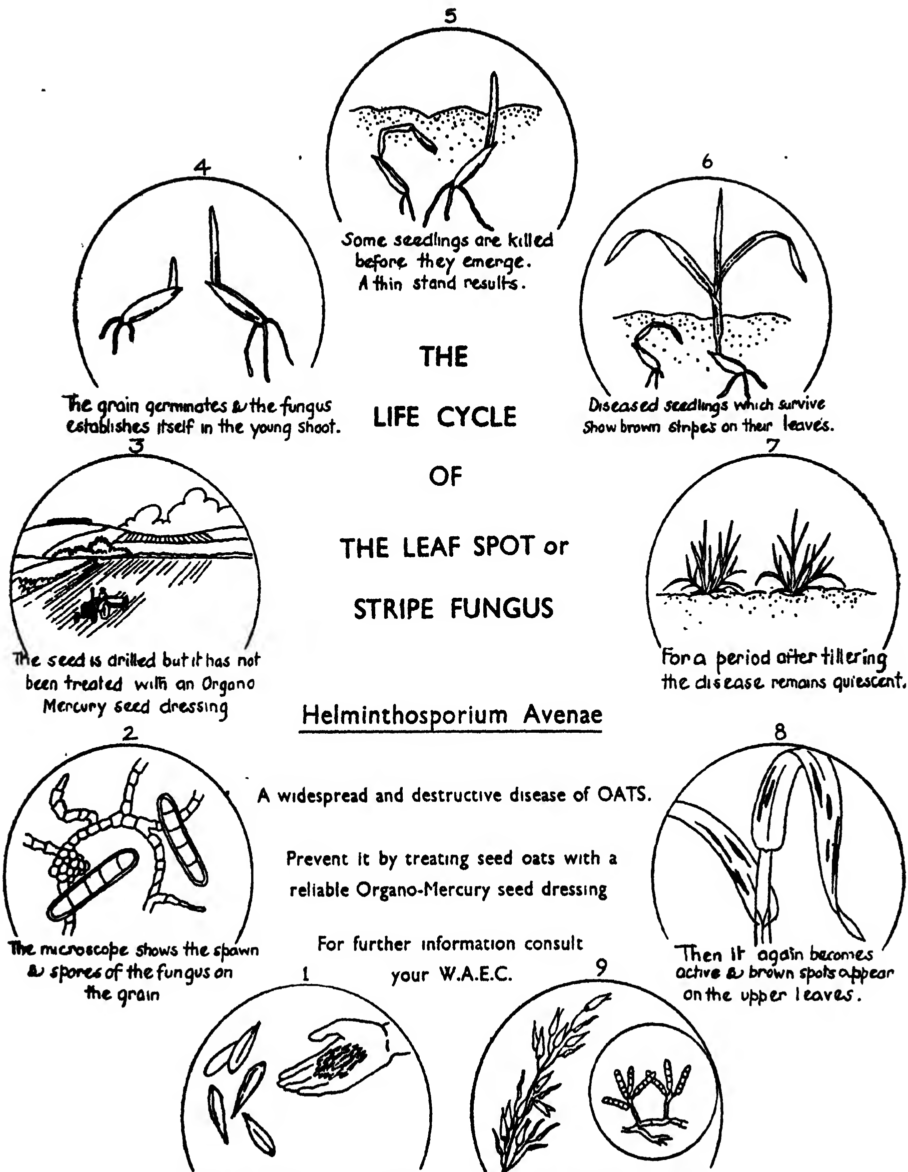
LEAF SPOT of oats, sometimes called Leaf Stripe, is a widespread and destructive disease caused by the microscopic fungus, *Helminthosporium Avenae*.

Although a sample of seed oats may, to the unaided eye, appear free from disease, it may not be so, for if examined under the microscope the resting mycelium and spores of this fungus may be found in the husk. Leaf Spot of oats is, therefore, a seed-borne disease, the course of which is described below.

Course of the Disease At the same time as the seed germinates the fungus on the grain awakens and starts to attack the young shoot as it attempts to spear through the soil. Very often, and particularly when germination is slow, this attack is highly successful, and some of the young seedlings are killed before they emerge. The plant pathologist refers to this condition as *pre-emergence blight*. Usually the farmer attributes the failure to wireworm or other insect pests, the weather or to inferior germinating capacity of the grain. It is true that certain weather conditions do favour this disease, but they are not the cause of it.

The seedlings which survive this attack show longitudinal brown stripes on their first leaves, which are caused by the fungus killing the green cells. As may be expected this unhealthy condition weakens the plant considerably.


THE
LIFE CYCLE
OF
THE LEAF SPOT or
STRIPE FUNGUS
Helminthosporium Avenae
A widespread and destructive disease of OATS.
Prevent it by treating seed oats with a reliable Organo-Mercury seed dressing
For further information consult your W.A.E.C.
1
This sample of seed oats looks clean but it is infected with the Leaf Stripe Fungus
2
The microscope shows the spawn & spores of the fungus on the grain
3
The seed is drilled but it has not been treated with an Organo Mercury seed dressing
4
The grain germinates & the fungus establishes itself in the young shoot.
5
Some seedlings are killed before they emerge. A thin stand results.
6
Diseased seedlings which survive show brown stripes on their leaves.
7
For a period after tillering the disease remains quiescent.
8
Then it again becomes active & brown spots appear on the upper leaves.
9
The spots on the leaves produce spores which infect the grain.

Not infrequently these symptoms are mistaken for wind or frost injury, and farmers expect that the crop will grow away clean and healthy. But this is not so; although for a period after tillering the disease does remain quiescent. Later, however, brown spots appear on the maturing upper leaves, and it is from these diseased areas that the spores arise which later infect the grain. The cycle is then complete.

Prevention by Seed Disinfection The losses caused by Leaf Spot of oats can be prevented by disinfecting the seed before sowing with a reliable organo-mercury dust according to the directions of the manufacturer. Seed already treated with an organo-mercury dust can be obtained from many seed merchants, but with home-saved seed the work must be done on the farm, and this requires the use of a machine.

It is bad practice to attempt to carry out the mixing operation in a sack, or by spreading the grain on a barn floor, scattering the powder over it, and then turning it over three or four times with a shovel. The most effective way is with a machine of the barrel or churn type, the mixing being done by rotation. Inexpensive machines of this kind can be purchased, but it is not difficult to construct a home-made one from a barrel or drum mounted so that it can be rotated by turning a handle.*

Another type of machine is that in which the mixing is done by the falling of the grain and powder over a series of cones contained in a hollow cylinder. This is a quick method, but the mixing is not as thorough as that obtained by "churning" the seed and powder together.

Warning Organo-mercury dusts contain a poison, and consequently care must be exercised in their use. Always follow the instructions given by the manufacturers. If grain is not well-conditioned and is slightly damp, it should not be disinfected in advance and stored, but should be treated immediately before sowing.

AGRICULTURAL IMPROVEMENT COUNCIL FOR ENGLAND AND WALES

SECOND NOTE ON PROGRESS

IN the last note on the Council's work† it was stated that the Joint Committee of the Agricultural Improvement Councils for England and Wales and for Scotland and the Agricultural Research Council had set up six groups each to make a careful survey of the knowledge available in a particular field and the extent to which it was being applied in practice; also to report on the most promising lines of research and the requirements necessary to their prosecution. Five reports have been received, and the sixth is in preparation; also three additional groups have been set up to work with Animal Nutrition, Poultry and Plant Pathology as the subjects for their inquiries.

* This is fully described and illustrated in Growmore Leaflet No. 48. *Dressing Cereal Seed*, obtainable free and post free from the Ministry, Berri Court Hotel, St. Annes, Lytham St. Annes, Lancs.

† *Jour. Min. Agric.* 50 (January, 1944), 464.

Of the reports received, that on horticulture has already been carefully considered, and it is hoped that some of its major recommendations may soon be adopted. The report on the control of bean aphis revealed the need for further research work before the suggested drastic methods for the elimination of this pest could be generally recommended. That on bracken disclosed how much has still to be learned about its habits and mode of life before a new means of control can be suggested with confidence. The A.R.C. has been asked to arrange, as far as it is practicable under present conditions, for the further work shown to be necessary before the control of bean aphis or of bracken can be achieved.

The application of scientific knowledge to Animal Breeding and Genetics presents a number of special problems which have been brought out in the group's report. They are, however, chiefly of a nature requiring the attention first of the A.R.C.; hence the A.I.C. has considered them only in outline. The group on Soils has only just reported and their findings have not yet been before the Council.

Hill Sheep The Report of the Committee on Hill Sheep Farming has been published and is now under consideration by the various departments concerned. The Council is following its progress with interest and has also taken up with the A.R.C. the recommendations for research work. Many of these problems were already under investigation; others cannot be tackled successfully until the hill sheep stations, suggested in the report, are available.

Experimental Husbandry Farms The need for stations where the impact of new knowledge on a particular system of husbandry can be carefully studied applies not only to the hill farms, but to all the main soil and climatic types throughout the country. The Council, in association with the A.R.C., has therefore instituted an inquiry into the possibility of providing a number of such farms, and as to the best organization both for the individual farms and the group as a whole. Associated with this problem of providing suitable backgrounds for the study of the application of research findings is the urgent need to provide facilities for the extension of soil research, variety trials and other investigations to soils and climatic conditions not found in the individual research stations. The inquiry has, therefore, been widened to see how far these needs can also be met on the same farms.

Surveys of Types of Farming In assessing the relative importance of problems placed before them, the Council has need of general descriptions of the main types of farming, the trends within each type, and the educational and research work required to enable the farmers to follow these trends and maintain an ever-rising standard of technical efficiency. To test the practicability of providing this information, two surveys have been carried out; one of farming on the chalk lands, and the other of the system of intensive dairy farming practised in such areas as the West Riding of Yorkshire. These surveys are now ready for submission to the Council.

A further survey has been made of the peculiar problems associated with the fenlands. This deals primarily with research problems arising from a characteristic soil, and not with a system of husbandry, except in so far as it is dictated by the soil.

Methods of Cultivation The preliminary inquiry into methods of cultivation arising out of the report of experiments carried out at Rothamsted has been completed, and no evidence

was found to show that the farmers practised those extensive cultivations which had been shown experimentally to reduce yields. Isolated instances were encountered where farmers had overworked land at the wrong time, but these were frankly cases of bad farming. On most farms the cultivations conformed closely to those which had been shown by the research workers to give the highest yields, and there was a general agreement as to the importance of weed control as distinct from any attempt to conserve moisture by the production of a dust tilth. It was therefore decided that it was unnecessary to pursue this inquiry further, the value of the Rothamsted work residing in the explanation of existing methods rather than in the introduction of any marked change in the cultivation of crops.

The examination of the depth of ploughing gave an entirely different result. The work at Rothamsted had shown that to deepen the ploughing from six inches to ten inches had no effect on yield. Farmers, however, were divided into shallow and deep ploughers, the former rarely exceeding six inches even on the rootbreak, whilst the latter considered anything under 12 inches as shallow ploughing and often drove in the plough to 18 inches, bringing up subsoil, clay or chalk. The general impression formed by visiting neighbouring farms where the different systems were followed was that the deeply ploughed land carried by far the better crops. The farms could not, however, be regarded as comparable, since they differed also in manuring and other treatment. It was decided, therefore, to put down a comprehensive trial on sixteen sites in Lincoln (Kesteven and Lindsey), Leicester, Essex, Hertfordshire, Hampshire, Warwickshire and Shropshire, covering as many soil types as possible. The experiments involved a considerable organization, but Dr. Ogg of Rothamsted willingly co-operated, and Dr. E. W. Russell undertook the work. All the first season's ploughings have been completed.

Artificial Insemination The Minister has now set up a Central Advisory Committee to advise him on the control of the development of artificial insemination on a commercial scale. The work which has been done at the Cambridge and Reading Centres under the A.I.C. Supervisory Committee has provided much of the information on which the Central Advisory Committee will work. With the setting up of this committee it appeared that the function of the Cambridge and Reading Centres as pioneer centres was fulfilled, and that they should no longer come under the A.I.C. but have a separate commercial existence. The Supervisory Committee was therefore dissolved and the Centres instructed to make their future arrangements with the Central Advisory Committee. In order, however, that the scientific aspects of the work should not be overlooked, a small joint committee has been set up composed of members of the A.I.C. and the Central Advisory Committee, whose duty it will be to bring to the notice of the former body any problems requiring investigation which may arise in the various commercial stations now being established. The A.I.C. will thus be able to continue to fulfil its functions of advising the A.R.C. on those aspects of research that need attention.

Seed Potatoes and Cereal Varieties The Committee set up by the Agricultural Improvement Councils for England and Wales and for Scotland to consider the production of seed potatoes has reported, and its findings have been accepted by both Improvement Councils and conveyed by them to the Ministry and the Scottish Office. A summary of this report has already appeared in this JOURNAL.* The Council has also considered, at the request of the National Institute

* January, 1945.

of Agricultural Botany, problems connected with the production of virus-free stocks of seed potatoes.

The corresponding problems of improvement in cereal varieties and limitation in the number grown were examined by one of the Council's *ad hoc* Committees. At the same time, the Seed Production Committee of the N.I.A.B. was examining this subject. The report of the Council's committee, after examination and approval by the Council, was therefore passed to the Seed Production Committee so that its recommendations could be considered in drafting any plan for the control or certification of cereals. A leaflet has been published by the N.I.A.B. giving an approved list of winter wheats,* which was one of the proposals made in the report submitted to the Council.

Investigation of Field Problems A number of inquiries has been started with the object of getting from the field more precise information upon problems requiring investigation. One of these, made by Mr. F. Hanley, is into the reported failures in bean crops. Over one hundred fields throughout the country have been observed from the first cultivation until harvest, and the results are being carefully examined. Another attempt to get further information by studying such details as could be collected of crops reported to have failed revealed no predominant cause.

A second inquiry has for its object the collection of information from counties of the expansion to be expected in the use of heavy implements, so that the Agricultural Machinery Development Board may be advised of likely trends.

A third inquiry aims at discovering whether farmers themselves have evolved any new methods of using surplus straw which might be publicized. One method for the utilization of surplus straw is the preparation of compost with sewage sludge. This, however, is only one aspect of the problem regarding the provision and best method of applying bulky organic manures. The Council is following with interest the work on sewage sludge, composts and farmyard manures which is being carried out under the A.R.C., and it has been able to circulate, through the T.D.C., a note on the results so far obtained. With the help of the Advisory Chemists, a study is also being made of those individual cases where sewage sludge or town refuse is used extensively.

Sunflowers and Maize A year ago the A.R.C. was able to state that certain imported varieties of sunflower and maize had been grown successfully in small-scale trials, and that they might be considered for wider use. Mr. G. E. Blackman, who had carried out the early trials, undertook to arrange with a number of farmers to grow these crops under commercial conditions. Although the season was unfavourable, the preliminary reports suggest that certainly sunflowers and probably maize have possibilities as farm crops in this country. Experiments were made in different methods of harvesting, and it was found that, with suitable precautions (including the use of a drier), the sunflowers could be "combined".† Steps are being taken to increase the stocks of seeds of known quality and to continue the experiments in 1945.

* Reproduced in this JOURNAL, September, 1944.

† *Jour. Min. Agric.* **50**, 517.

Weed Control by Chemicals The work sponsored by the A.R.C. on the chemical control of weeds* is having very important results. A preliminary report has been sent to counties giving the information so far obtained, and the work is being extended. One difficulty experienced has been the rapid depreciation of the spraying machines used for the application of various chemicals, and the Council, in conjunction with the A.R.C., the Agricultural Machinery Development Board, the Department of Scientific and Industrial Research and the Ministry of Supply, instituted an inquiry into the design of these machines. Manufacturers are being consulted, and it is hoped that a reasonably priced machine, capable of being used for weed and pest control, may be evolved.

Iodinated Proteins for Dairy Stock An extensive experiment on the subject of increasing milk yields by the feeding of iodinated proteins has been carried out on behalf of the Council and the A.R.C. by the Ministry's Veterinary Officers. The results have been examined and the findings will be published in the near future. It may be stated here that the conclusions were definite, and will form the basis on which farmers may be advised and this new product properly controlled.

These notes cover only a section of the Council's work, much of which has not yet reached a stage when any announcement can be made. The coming year will also present the Council with many new problems, prominent amongst which is the responsibility of advising the Minister upon various aspects of the new National Agricultural Advisory Service.

THE TRANSPORT OF IMPLEMENTS

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THE life of many farm implements is materially shortened by damage during transport from one field to another. This is naturally more common with steel-wheeled implements than with implements fitted with pneumatic tyres. Over long distances the former should, whenever possible, be moved on a trailer. Where this is not possible, the following precautions should be observed:

Before Transport

1. All parts, such as the coulters or shares on a plough, should be checked to see that they are tight. They may easily be lost, due to slackness developing from the vibration caused by travelling.

2. Wheel spuds should be removed.

3. All road wheel bearings should be greased thoroughly.

4. Implements should be set in the highest position to avoid catching surface irregularities.

5. If there is any likelihood of the trip mechanism engaging because of vibration, it should be secured by a piece of baling wire or stout string.

* *Jour. Min. Agric.* **51**, (April, 1944), 38.

During Transport

1. No steel-wheeled farm implement should be towed on a hard surface at a speed greater than 3–4 miles per hour.

2. A strict watch should be kept on the machine to see that no parts are working loose, or that the trip mechanism is likely to drop the implement.

3. On long journeys wheel bearings should be re-greased at least every five miles.

4. Drawbar pins should have a nut or some other means of preventing them from jumping out of their holes.

5. Particular care should be exercised in taking wide implements through farm gateways.

After Transport

The implements should be inspected closely and any loose nuts tightened at once.

FARMING NOTES

Cereals for Spring Sowing The best corn crops are usually obtained from the earlier sowings. With spring wheat it is necessary to make up for lost time, wheat normally being a cereal that is sown in the autumn. Accordingly, we must make the conditions for growth as favourable as possible: thicker seeding, because there is no time for tillering; a fine tilth and a dressing of fertilizer, such as 1 cwt. sulphate of ammonia and 2 cwt. superphosphate per acre, so as to encourage rapid, regular growth and early, uniform ripening.

Wheat Some of the early-maturing autumn varieties, including Holdfast, Yeoman, Little Joss and Squarehead's Master, will ripen if sown not later than mid-February. The first two varieties have short straw and suit highly fertile soils; the last two have longer straw and do best on soil of only moderate fertility.

Some other varieties may be sown as late as April, but even these are likely to give higher yields when sown in February or March.

For sowing up to the end of March, there is the well-known variety, Red Marvel. Its straw, however, is rather long and weak and it usually could, with advantage, be replaced by Atle. This variety grows to about the same height as Holdfast; its grain is red and of good milling quality. For still later sowing, Fylgia has good, short straw and suits the more fertile soils; Diamond II is adapted to soils of medium fertility, while April Bearded, with long, weak straw, should be reserved for the poorer land.

Barley Spratt-Archer and Plumage-Archer are the leading malting barleys. The former is suited to soils of average fertility, the latter is rather better adapted to soils of higher fertility. Compton is not regarded as a malting barley. It is, however, quite suitable for growing on the richer soils for feeding purposes. Kenia ripens early and has short straw which stands well on rich soils. It is finding favour for combine harvesting and although its grain is not of high quality, it is not to be ruled out for malting purposes when crops are well grown and allowed to become fully ripe before harvesting.

Oats For general cultivation, the following varieties are all suitable: Eagle, Onward, Star, Victory and Golden Rain. Eagle has shown some resistance to frit fly and may be sown with advantage on fertile soils if seeding has to be rather late. It stands well and the grain is of good quality. Onward is a heavy yielding oat, also of good quality, but with rather soft straw of medium length which needs to be cut early to avoid waste. Star and Victory are two of the most reliable oats in cultivation. The former stands up a little better than the latter.

Resistance, Marvellous and Aberystwyth S.147 are recommended for sowing early on good soils. Excellent crops of Marvellous are grown in North Wales when sown in April. Resistance has the shortest straw and suits the richest land. Supreme (black) has short, stiff straw and ripens early. It seems well adapted for combine harvesting. Other early-ripening varieties with good straw are: Early Miller, Ayr Bounty and Aberystwyth S.84. They are well adapted to districts with high rainfall.

Good News for Poultry-Keepers Some significant changes in the formulae of the National Poultry foods are indicated by the publication of amendments to the Feeding Stuffs (Regulation of Manufacture) Order, 1944—changes which will be welcomed by poultry-keepers as an augury of better times to come.

Briefly, they consist of the reappearance of maize meal as an ingredient of poultry foods, and the reduction of the fibre content. National Baby Chick food is to contain a minimum of no less than 20 per cent. of maize meal, and other poultry foods are to contain a minimum of from 5 to 7½ per cent. To ensure that available supplies of maize meal are fairly distributed, it will be necessary to limit the maximum amounts of maize in poultry foods to 25 per cent. in the case of National Baby Chick food, and 15 per cent. in other poultry foods. In addition, the permitted maximum amount of fibre has been reduced by amounts varying from 0.5 per cent. and 1.0 per cent. of the maxima permitted hitherto, and the use of wheat by-products containing a fibre content of more than 11 per cent. has been prohibited in National Baby Chick food, and National Poultry Foods No. 2 and 2A. (The previous figure was 11½ per cent.) The effect of these changes will be to increase the available energy content of poultry foods, and to encourage the more extended use of the finer wheat offals. This means that poultry-keepers will be able to obtain better growth in chicks, and better egg production from layers, on a smaller consumption of feeding-stuffs.

It may not generally be appreciated that for some time now provision has been made for the manufacture under licence of a breeders' mash or pellets (National Poultry Food 3A) to encourage the production of eggs of high hatchability. It is a scientific fact that a shortage of vitamins in a breeders' mash will result in the production of eggs of low hatchability, and in this mash provision is made for an adequate vitamin content by the inclusion of milk products, good quality dried grass meal or lucerne meal and cod-liver oil.

Poultry (Stock Improvement) Advisory Committee The Minister of Agriculture and Fisheries has constituted a Poultry (Stock Improvement) Advisory Committee to keep under review the position of the stock-producing and distributing sections of the industry, to advise on existing measures designed to encourage the production of high quality breeding stock, and to suggest from time to time any further steps which they consider should be taken to secure that end.

The Chairman of the Committee, which is representative of all sections of the poultry industry, is Sir Donald Vandepeer, K.B.E., Second Secretary of the Ministry of Agriculture and Fisheries. The Vice-Chairman is Mr. P. A. Francis, O.B.E., and the Secretary is Miss V. C. Lawe, Ministry of Agriculture and Fisheries, Africa House, Kingsway, London, W.C.2.

Marketing of Wool In answer to a question in the House of Commons on December 5, 1944, the Secretary of State for Scotland said that he and the Minister of Agriculture and Fisheries had decided to set up a Wool Marketing Committee with the following terms of reference:

"To examine the pre-war arrangements for the marketing of wool by producers in Great Britain, and the changes introduced under war-time control; and having regard to the views and recommendations of the Committee on Hill Sheep Farming in Scotland, as set out in their report of December, 1943, to the Secretary of State for Scotland, to consider whether the organization of wool marketing after the war could be improved through the medium of a scheme under the Agricultural Marketing Acts, 1931–1933, or by any other means, and whether conditions and requirements in England, Wales and Scotland respectively are such as to necessitate separate and different arrangements in regard to wool marketing in any of these countries; and to report accordingly."

The members of the Committee are:

Lt. Col. The Rt. Hon. Walter E. Elliot, M.C., M.P. (Chairman)
Mr. J. Bowman
Mr. D. O. Evans, M.P.
Mr. T. G. Henderson
Sir Harold G. Howitt, D.S.O., M.C., F.C.A., J.P.

The Secretary of the Committee is Mr. A. H. Clarke of the Ministry of Supply, and the Assistant Secretaries are Mr. G. S. Baker of the Ministry of Agriculture and Fisheries and Mr. A. F. Smith of the Department of Agriculture for Scotland.

Communications for the Committee should be addressed to the Secretary, Wool Marketing Committee, Ministry of Agriculture and Fisheries, Africa House, Kingsway, London, W.C.2.

Waterproof Whitewash Mr. M. D. Graham, Agricultural Officer of the Department of Agriculture, Kenya, writing in the East African Agricultural Journal, gives a useful recipe for waterproof whitewash. It has withstood high rainfall and even severe hail where the plaster is hard enough to resist pitting. The wash is made up of: unslaked lime or lime oxide, 7½ lb.; rock salt, 1½ lb.; and cement, ¾ lb.

Dissolve the salt in 1 gallon of cold water. When completely dissolved pour on to the lime. Then add to the lime 1½ gallons of water, *slowly* allowing it to slake. Add the cement by sprinkling on a little at a time when the lime is almost slaked. Stir thoroughly. It is advisable to use a trough-like receptacle for the preparation of this limewash, because terrific heat is generated during the slaking of the lime. The use of a narrow-mouthed mixing vessel can very easily result in a mild explosion caused by the steam, with probable serious burns to the operators.

It is highly important that as soon as the lime has slaked the wash should be applied *immediately and while still hot.*

The quantity of water required is by no means constant. It will vary with the quality of the lime used, some slaking quickly, some slowly, so

that each type generates heat at a different rate. Thus more or less water is lost as steam, according to the quality or type of lime used. Rock forms slake slowly, but the powders are almost instantaneous. The ideal mixture should have the consistency of rather thick distemper. A little water may have to be added to the last gallon or so of mixture. Keep stirring constantly. It pays to have two people on the job, one to stir and prepare the batches of wash and one to apply it.

The surface to receive the whitewash must be free from old flaking lime or other washes. One advantage of this wash is its power of penetrating the plaster, whether the latter is cement or lime. Thus a clean surface will ensure success.

For internal use this whitewash has also been most useful, because it can be washed, even scrubbed, without coming off.

The whitewash takes about two days to harden sufficiently to withstand heavy rain, and, for external work, it should preferably be applied in dull weather.

Preserving Wire Netting Wire netting can be well preserved if coated with a mixture of cement and tar. Only a small amount of cement is required.

Education in Rural Areas "The country is the best place for a child to be educated." This claim was made by Miss Martha McCullock, a Lancastrian school teacher, in the *Country Magazine* programme, broadcast in the B.B.C. Home Service on January 14. She went on to say: "The happiest period of my own life was spent in a modern school with a large and lovely garden, where there was a lovely copper beech tree, under the boughs of which we were taught. I'm speaking as a teacher, and my teaching has been done in town schools where I had to try and supply that natural background with aquariums, gardens in boxes, nature tables and so on. Rural schools should give a better education than urban schools, but in fact they do not. You don't get the best teachers in rural schools. Some stay and prefer to teach in the country, but the most highly trained and most eager teachers tend to go to the urban districts, where there is better pay, greater opportunities for promotion, and, of course, the usual amenities. Then again, the village unit is too small as a rule for specialized services.

"Modern agriculture demands a range of skill comparable with that demanded by the urban industries, and the farm worker's education should be of as high a standard as the town worker's. Education is meant to fit young people for life; to make them healthy, happy, intelligent human beings."

Miss McCulloch sees the major problem as one of transport. She suggested that the children should be provided with education suitable to their capacities. The academic and technical types should be taken to secondary or technical schools by car or bus; the sub-normal and maladjusted should go to special schools and classes and child-guidance clinics.

"Another and important point," she said, "is that teachers' salaries should be paid according to their qualifications, irrespective of the type of school in which a teacher serves. Of course, these things are getting under way, but we've a very long way to go."

OFFICIALLY APPROVED INSECTICIDES AND FUNGICIDES

Since the date of the list published in the November, 1944, issue of this JOURNAL (p. 383), the following have been added to the list of proprietary products officially approved for the control of plant pests and diseases.

GROUP C: LIME SULPHUR WASHES

Vitax Lime Sulphur	Ormskirk Fertiliser Co.	C 122

GROUP D: MISCIBLE TAR OIL WINTER WASHES

Pestdoom Miscible (Black) Tar Oil Winter Wash	The South Bank Chemical Co. Ltd.	D 120

GROUP G: DERRIS AND LONCHOCARPUS INSECTICIDES TO BE USED AS DUSTS

Boots Derris Dust	Boots Pure Drug Co. Ltd.	G 123
Mon rose Derris Dust	Geo. Monro Ltd.	G 117
Mon rose Insect Dust	Geo. Monro Ltd.	G 118
Rotomort Derris Dust	Murphy Chemical Co. Ltd.	G 105
Vitax Derris Powder	Ormskirk Fertiliser Co.	G 119

GROUP H: DERRIS AND LONCHOCARPUS INSECTICIDES TO BE USED AS SPRAYS

Boots Derris Insecticide	Boots Pure Drug Co. Ltd.	H 124
Dactinol	W. J. Craven & Co. Ltd.	H 92
Dextrak Derris Extract	Murphy Chemical Co. Ltd.	H 114
Garantone	Murphy Chemical Co. Ltd.	H 106
I.T.P. Liquid Derris	International Toxin Products Ltd.	H 101
Morto Derris Insecticide	Murphy Chemical Co. Ltd.	H 107
Rotane (Derris Solution)	Technical Products Ltd.	H 102

GROUP J: COPPER FUNGICIDES (EXCLUSIVE OF SEED DRESSINGS) TO BE USED AS DUSTS

The chief crops for which the products are recommended are given in brackets; the labels of the products give full uses and instructions.

Longmate's Bordeaux Fungicide (*potato, celery*)	E. C. Longmate Ltd.	J 127
Longmate's Original Copper Dust (*hop, apple and pear*)	E. C. Longmate Ltd.	J 128
Murphy's Copper Lime Dust ((*hop, apple and pear*)	Murphy Chemical Co. Ltd.	J 116
Murphy's Potato Fungicide (*potato*)	Murphy Chemical Co. Ltd.	J 115

GROUP K: COPPER FUNGICIDES (EXCLUSIVE OF SEED DRESSINGS) TO BE USED AS SPRAYS

The chief crops for which the products are recommended are given in brackets; the labels of the products give full uses and instructions.

Boots Cheshunt Compound (*for damping-off diseases only*)	Boots Pure Drug Co. Ltd.	K 125
Bouisol (*tomato, rose*)	Boots Pure Drug Co. Ltd.	K 130
Coppesan (*potato*)	Boots Pure Drug Co. Ltd.	K 126
Fungex Liquid Copper Fungicide (*tomato*)	Murphy Chemical Co. Ltd.	K 121
Ialine Colloidal Copper Compound (*hop, apple and pear*)	Burt, Boulton & Haywood Ltd.	K 96

OFFICIALLY APPROVED INSECTICIDES AND FUNGICIDES

There are no additions to be made to the lists of approved lead arsenate powders, lead arsenate pastes, stock emulsion tar oil winter washes and organo-mercury dusts published in previous issues. Further applications for approval in all the above groups, and for the approval of copper sulphate and wetters and spreaders, are invited.

It should be clearly understood that products in groups other than those named above have not yet become eligible for consideration under the scheme.

A leaflet giving the complete list of the proprietary products so far approved may be obtained on application to the Secretary of the Advisory Committee at the address given below.

Ministry of Agriculture and Fisheries,
Plant Pathology Laboratory,
Milton Road,
Harpenden, Herts.
January 13, 1945.

NOTICES OF BOOKS

An Introduction to Breeding Farm Animals. LAURENCE M. WINTERS. Chapman & Hall. 12s.

Both the theoretical and practical aspects of breeding are covered in this interesting book, which is designed primarily for students of agriculture; it is rather too technical in places to appeal to many farmers. Now that so much attention is being given to live stock, this book is of particular value to British agriculturists. Although written from the American angle, the subject matter applies appositely to British farming. Speaking of America and her live stock, the author says: "This country possesses many fine herds . . . the equal of any in the world. But many farmers still raise inferior stock; the result of this is that the average merit of stock produced in this country is far too low." The same allegation as regards British live stock is being made over here. He also appeals for efficiency through good management; concentration on rations is not sufficient. "Heredity," he says, "is fundamental, and may be likened to the foundation of a building. Environment is required to complete the structure just as builders and materials are necessary to complete a building."

It is interesting to find a new form of livestock recording being discussed—for beef cattle. The author realizes fully the importance of performance in type and character, and when live stock are exhibited at shows he advocates that more prizes should be given for performance than for appearance. Artificial insemination is discussed at length, although its value to small herds is not mentioned. (Obviously this aspect is not so important in America as in Britain.)

The concluding chapter, dealing with the establishment of flocks and herds of various farm animals and poultry, summarizes the book excellently. Here again, selection for performance is emphasized, for the author advises building up herds or flocks of animals of outstanding performance and breeding ability. What better advice could be given?

This is undoubtedly a valuable book, well written and well illustrated, and it can be recommended particularly to those students still at college or university. By it they may be encouraged to study animal husbandry problems more deeply, bearing in mind the author's remark: "Research in the field of animal breeding has scarcely begun".

The Farmer's Animals. FRANK H. GARNER. Cambridge University Press. 4*s.* 6*d.*

With a commendable economy of words Mr. Garner has succeeded in providing a most useful introduction to farm live stock and their management. The facts concerning the various breeds of cattle, sheep and pigs are set out succinctly, and the absence of technicalities will be welcomed by the townsman who wishes to know more

about the farmer's animals, the various breeds, the methods of housing and feeding them and the care required during the rearing of young stock.

The author deals adequately with the multiplicity of sheep breeds; and after reading what he has to say about the careful preparations necessary for lambing time, the page will be turned with a greater regard for the skill of the shepherd and the work he does. The fattening of cattle and sheep for market are dealt with, as well as the various classes of pork and bacon pigs.

Horses, poultry and goats have not been forgotten, and the book is well illustrated with clear photographic examples of the subjects under discussion in close relationship to the text.

This Milk Business. ARTHUR GUY ENOCK. H. K. Lewis & Co. 18*s*.

The author of this book is acknowledged as a pioneer and an authority in dairy engineering. During his association of nearly 50 years with the dairy industry, he has combined a considerable degree of idealism with highly skilled technical engineering development. It is not surprising, therefore, that in reviewing the progress in milk distribution during this period the author should introduce a measure of personal experience and impressions on major developments and leading personalities.

The reader will find much useful information dealing with the place of milk in national nutrition, the economic position of the dairy industry, the fight against disease and contamination, the problems of handling, transport and distribution, and the modern methods of handling and processing liquid milk for human consumption. Special sections are devoted to methods of pasteurization, and include a survey of the development, practical application and advantages of the "in bottle" system, which the author regards as the ideal process. Finally, a comparison is drawn between old and new methods of distribution, and from his wide experience Mr. Enock suggests a possible form of reorganization of the dairy industry. There is little doubt that this book will be widely read.

Good Soil. (Teach Yourself Farming Series). S. G. BRADE-BIRKS. English Universities Press. 3*s*.

The second volume in this new series of *Teach Yourself Farming* should fill a much-felt want. It is an elementary book on soil science; nevertheless, the hardened soil scientist will find some things in it that he can read with profit. Dr. Brade-Birks avoids entirely the horrible jargon of technical pedology that makes the reading of most soil books a burden. His argument is that the main task of the soil scientist is to organize and systematize the everday knowledge of soils that every farmer possesses. Most of the book is devoted to simple explanations of phenomena encountered continuously by everybody who handles soil. The author is at pains to show that "the individual soil is a natural object"; but here he does fail, like all others who have used the same phrase before him, to show that it means anything in particular. The most striking property of a soil as a "natural object" is its structure, to which very little space is devoted.

Dr. Brade-Birks is best on the practical applications of soil science to agriculture and many instructive illustrations are given of the influence of different soil conditions on the development of British farming, and of how the farmer can learn to adapt his cropping practices to his soils. The description of the American system of soil classification, which the author recommends for use in Britain, and of the methods of defining and recognizing soil types is very well done. The book covers a great deal of ground, and some aspects of pedology, particularly of the world distribution of soil-type zones, are rather too sketchily treated to be informative to the uninformed, but in the main it fulfils very effectively its aim of helping the farmer to make all his soil good soil, and the layman to recognize a good one when he sees it.

Charter for the Soil. JOHN DRUMMOND. Faber and Faber. 10*s*. 6*d*.

Mr. Drummond would bring to the people of Britain direct from her farms, fresh, nourishing, palatable food, graded, dated and clean. The farmer would secure good prices, the public better food at no greater cost and without subsidies, and the land maintain full production and fertility.

The most nourishing foods—milk, eggs, vegetables, pig products and a range of fruit—are just those which our soil and climate can produce economically against all competition. Mr. Drummond, himself a farmer, shows how the consumer can be

wooed to buy them against rival claims on his purse; but quality, flavour and appearance, are essential factors. The farmer must capture and keep the direct goodwill of his real customer—the British public. But, the author contends, he cannot do this nor obtain better prices, nor the public better food, if distribution of perishable foods is allowed to pass through so many stages as at present; the twenty "foreign" surfaces that much of our milk now passes over might, he claims, be reduced to four.

How shall the farmer and consumer reap these gains ? The answer, Mr. Drummond says, lies in co-operation by farmers working in units of ten farms on a central estate plan. Produce could be sent, graded, packed, dated, and transported in refrigeration vans direct to estate shop sites to serve 2,000–3,000 "tied" customers. Granted the feasibility of tying shop and estate, but we may ask what consumer will allow himself to be tied to one food store when rationing ceases ?

The financial skeleton is not brought out of the cupboard, but the author agrees that his "charter" must stand trial. His imagination, analysis of "consumer complexes," and some shrewed and lively thrusts are calculated to get the nation and her farmers working together. Altogether, this is a thoughtful, stimulating and interesting book—one of the best of its kind.

Harvesting by Combine and Binder. (Farmers' Bulletin No. 9.) Department of Agriculture, Cambridge University. *2s.*

This investigation of the economics of harvesting covered thirty combines and twenty binders working in south Cambridgeshire and adjoining counties during the 1943 harvest. The combines were divided into three groups: those with 5-ft. and 6-ft., 8-ft and 12-ft. cutter-bars; and the operations grouped under three headings: Field Costs, Granary Costs, and Straw Handling Costs.

The average harvesting cost for a 12-ft. self-propelled combine was little less than that for the small machines, mainly because the lower labour charges with the large machines were offset by their higher depreciation per acre. The total cost of combining varied from £1 8s. 11d. per acre when the straw was ploughed in or burnt, to £1 19s. 11d. per acre when the straw was baled.

The 1943 harvest was exceptionally dry in the district covered, and grain drying was unnecessary. The granary costs were 6s. 6d. per acre, including dressing and sacking, the cost of which would have been included in that of drying had a drier been necessary. Even so, normally, when drying has to be done, the granary costs would be considerably higher. Harvesting costs for corn stacked and threshed in the usual way were £3 3s. 3d. per acre, but were reduced to £2 2s. 1d. per acre when the crop was threshed from the stook.

The combine's greatest advantage was the saving in labour. Small machines used less than half the labour required for normal methods, and the larger combines reduced the labour still further.

Combine Harvesting and Grain Drying (2nd edition). THE NATIONAL FEDERATION OF GAS COKE ASSOCIATIONS. *2s. 6d.*

Much of the subject matter of this very useful little book is necessarily the same as that contained in the first edition. Information gained through further experience in the field has, however, been added. The disposal of straw is discussed at greater length and the Table of critical drying temperatures is now in line with that agreed by the various interests.

The notes on storage and the handling of grain in storage bins have been extended. Descriptions and illustrations of driers and furnaces have been brought up to date. A few paragraphs on the operation of driers could with advantage be included in future editions.

The chapter on costs should be carefully studied by all those farmers who are contemplating adopting this system of harvesting.

A Scientific Policy for British Agriculture. PARLIAMENTARY AND SCIENTIFIC COMMITTEE. *9d.*

This is a report by an unofficial group of members of both Houses of Parliament and representatives of certain scientific and technical institutions, in which they advocate a post-war policy for British agriculture on scientific lines co-ordinated with the country's nutritional requirements.

NOTICES OF BOOKS

In endorsing the recommendations of the United Nations' Conference at Hot Springs (1) that farming systems should be designed to give an adequate return for labour and maintain soil fertility and protection from livestock and crop diseases, and (2) that the production of nutritionally desirable foods not easily obtainable elsewhere should be the special obligation of every country's agriculture, the Committee proposes that the bases of our agricultural policy should include the retention of a substantial acreage under the plough, balanced, mixed, rotational farming, a soil-climate basis in devising policy and appropriate dispersion of live stock and certain crops. Price guarantees are advocated as essential for economic stability. The need for better and improved drainage, power and water supplies for the modernization of buildings and equipment is emphasized.

The Committee considers that much more could be done to bring valuable results of research to the knowledge and into the practice of the British farmer. At the same time it is pointed out that the amount spent on research is about a quarter of one per cent. of our agricultural output, and an increase in the expenditure on agricultural research to at least £3 million a year is suggested.

Agricultural Production in Continental Europe during the 1914-18 War and the Reconstruction Period. League of Nations. Allen and Unwin. *7s. 6d.*

It has long been known that the League of Nations had prepared a comprehensive report on the fall of agricultural production in Europe during the 1914-18 war, and the rate of post-war recovery. For many years, however, it remained unpublished although recognized experts were allowed to consult it.

By 1919 the fall in production of cereals and potatoes, taken together on a calorie basis, was about 33 per cent. for all Europe, as compared with the average production for the four years 1909–1913. Imports of food from overseas were also down. War casualties had been about six million, mostly young men, out of a total population of 237 million, but even after allowing for this the food supplies per head were greatly reduced. Recovery of production of potatoes was, however, rapid especially in Eastern Europe; for Europe as a whole it was complete by about 1922, though in Western Europe it took much longer. Cereals also recovered more rapidly in Eastern Europe than in the West, though this was partly due to a reduction in consumption of cereals per head following an increased consumption of other foods, a process which has been marked in Britain.

Live stock suffered heavily during the war. The number of cattle fell by about 10 per cent., except in the battle area where the loss exceeded 20 per cent.; recovery was slow, and in large areas incomplete by 1928, though in the fighting zone the losses had been made good by 1924. For pigs the losses were large but variable, ranging from 70 per cent. in the coastal regions of Holland and Denmark to 20 per cent. in parts of Germany; recovery, however, was rapid.

The figures show how closely livestock recovery is dependent on food supplies for the animals, and they demonstrate the futility of importing animals to the Continent until sufficient food is in sight to assure good levels of milk and meat production.

This book has appeared most opportunely, when the Agricultural Committee of UNRRA is facing similar problems in rehabilitating European agriculture.

Weatherwise. John H. Willis. Allen and Unwin. *7s. 6d.*

From observations taken over the period 1913 to 1942, Mr. Willis has pieced together in narrative and Table, a picture of the weather as recorded at his climatological station near Norwich. But, as "one swallow does not make a summer" (and quotations from weather lore, such as this, abound in the book), so the observations made from a single station cannot be accepted as representative of the weather of the country as a whole, despite the author's statement to the contrary. Perhaps the most interesting and valuable part of the book is the series of photographs showing the same clump of flowers or tree branch on the same date in different years The contrast, for example, between a beech branch on May 1, 1926, and on the same date three years later is a graphic commentary on the vagaries of our climate.

Nature Conservation and Nature Reserves. Report by a Committee to the British Ecological Society, 1944. Cambridge University Press. *1s. 6d.*

The pressure of the changes involved in the coming of the scientific age, to which Sir William Bragge referred in a broadcast last year, is heavy enough on human beings,

but it is still greater on those wild animals and plants which constitute such an important part of our environment. Hence the setting up of committees to consider questions of nature conservation. Ecologists are scientists whose main concern is the study of plant and animal communities. To take three very different habitats as an example, they study the way in which vegetation as a whole develops in the chalk country, on a sandy heath, and on a sand dune; and they trace the interrelations of the common, as well as of the rare, species of plants and animals present. Not unnaturally, they view with alarm the dwindling area of unspoiled land where the natural forces can work more or less undisturbed, and this report emphasizes the urgent need for action.

The Committee's main recommendation is that the State should assume formal responsibility for the conservation of native wild life and should set up a central authority, to be termed "The Wild Life Service," as an independent body under the Privy Council. This authority, which would have expert personnel, would acquire and administer a limited number of national nature reserves representing the more important types of British vegetation with the associated animals. The authority would also encourage local bodies—such as County Councils—to form local nature reserves, and would advise on their management.

In the space of a short review it is impossible to do justice to this well-written, and carefully prepared report. It contains an interesting survey of the aims and objects of nature conservation, showing the different interests which attach to amenity, science, education, and economics. The report, which also discusses in a temperate and scientific spirit the influence of woodland improvement, together with large-scale afforestation, on the problems of nature conservation, may be strongly recommended to all naturalists and lovers of nature.

BOOKS RECEIVED

Thirty Years of Farming on the Clifton Park System. William Lamin. Faber & Faber. 7s. 6d.

A Textbook of Dairy Chemistry; Vol. 1—Theoretical. Edgar R. Ling. Chapman & Hall. 13s. 6d.

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ARTIFICIAL INSEMINATION OF CATTLE

THE practice of artificial insemination is not new. There is some evidence that the method was known and used by Arab horse breeders more than 600 years ago, and there is an authentic account of its use in the successful insemination of a bitch in 1780. The development of the method on a commercial scale is, however, of comparatively recent origin. The first artificial insemination centre in the United States was established in 1937, and during the year 1943 some 574 bulls were used to inseminate 182,524 cows, an average of 318 cows per bull. Large numbers of cattle and sheep have also been bred by this means in Russia.

In this country, pre-war experience was limited to research, and the first two trial centres were set up in 1942—at Cambridge and Reading—on the recommendation of the Agricultural Improvement Council and financed from public funds, with the object of ascertaining whether artificial insemination offered a practical and economic means of livestock improvement for the smaller herds of this country.

Advantages of Artificial Insemination The work at Cambridge, Reading and elsewhere has demonstrated that artificial insemination is a practicable and, given suitable conditions, dependable system of cattle breeding, and that the resultant calves are healthy and true to type. It is also a method whereby far more cows can be inseminated by a single bull than is possible by natural means. It should, therefore, be a valuable instrument in the improvement of our live stock, particularly among the smaller herds which cannot normally command the services of a high-class bull.

Artificial insemination has also been proved to be of considerable assistance in preventing the spread of certain breeding diseases which are communicable by the bull—notably trichonomiasis. A wave of this disease in the Vale of Clwyd has been successfully overcome through the operations of a small artificial insemination centre established by the Ministry in 1943 specifically for this purpose.

Technique A quiet cow, not necessarily in season, is confined in a service crate and when the bull jumps her his semen is collected in an artificial vagina. A sample of semen is tested under the microscope for motility, and the remainder is immediately mixed in an egg-yolk phosphate or egg-yolk citrate diluter. The mixture is kept in a refrigerator at about 5° Centigrade. A dilution of 1 to 4 is generally used: in experimental work, dilutions of 1 to 16 have been used successfully. Satisfactory samples of semen can be kept for 3–4 days, and some samples have given satisfactory results up to 6 days. The method of insemination is to insert about 1 c.c. of the diluted semen into the uterus by means of a glass tube.

These operations may appear simple but they are all highly technical and delicate and require the services of adequately trained personnel. Valuable bulls can be permanently injured by careless handling during service, and even if they are not injured seriously they may develop a distaste for the method and refuse to function. The handling of the semen also requires great care; temperatures must be properly adjusted, scrupulous cleanliness must be observed by the operational staff, and all instruments and containers must be thoroughly sterilized. Success or failure largely depends upon the man in charge of operations and, in this country, it is required that he shall be a qualified veterinary surgeon. It is not necessary that he shall personally carry out all the operations—he would normally have trained "lay-inseminators" and laboratory assistants working under him—but the veterinary surgeon is the key-man of the centre and must be responsible for the work of his staff.

Dangers of Uncontrolled Development Much still remains to be learnt about the choice and management of bulls, insemination technique, the problems associated with the storage and transport of semen, and the training of personnel; more experience is also needed before the economic factors necessary to the success of an artificial insemination centre can be determined. The optimum size of an operational unit, the area of operations to be covered by a centre, the minimum capital requirement, the cost of, and hence the charge to be made for, insemination, and the possibilities of developing sub-centres drawing semen in bulk from a parent centre, are all matters on which further knowledge must be gained.

It is essential, therefore, that progress in the establishment of a national service of artificial insemination shall be gradually made and carefully undertaken. Recognizing the difficulties as well as the advantages, every effort must be made to avoid the pitfalls which would lead to disappointment and financial loss and might bring this method of livestock improvement into general disrepute.

Legislative Action The necessity for the Government to exercise control over the development of artificial insemination was recognized by Parliament in the passing of the Agriculture (Miscellaneous Provisions) Act, 1943, which empowered the Minister to prohibit, by

Regulation, the sale and distribution of semen except under licence. The Artificial Insemination (Cattle) (England and Wales) Regulations, 1943, prescribe certain basic conditions of licence, while authorizing the Minister to specify such other conditions as he may think desirable. Without a licence granted under these Regulations, artificial insemination may not be used for cattle except where the bulls and cows concerned are in the same ownership.

The main requirements before a licence can be granted are that the premises, equipment, bulls and personnel of each centre shall be approved, that adequate records shall be kept, and that the operations shall be under the control of an approved veterinary surgeon.

In addition to the licensing of centres specially set up for the purpose of artificial insemination, the Regulations provide for licences to be granted for the distribution of semen by other bull owners in special circumstances. Licences of this kind are granted for special insemination of cows registered in the same herd-book as a bull with which a mating is desired but would not be practicable by natural means, for disease treatment, and for purposes of research. Strict limitations are imposed by such licences upon the number of inseminations which may be carried out.

To assist him in the consideration of applications for licences and in the proper development of artificial insemination generally, the Minister has appointed the Central Advisory Committee on Artificial Insemination which, under the chairmanship of the Duke of Norfolk, is actively considering present developments and future plans. A further body, the Joint Standing Committee on Artificial Insemination (Research), has been appointed by the Central Advisory Committee and the Agricultural Improvement Council to guide and co-ordinate research in this field.

Artificial insemination is not likely to play so prominent a part in the breeding of beef cattle as it will with dairy cattle ; it is not always easy to identify oestrus in suckling cows, particularly when grazing in remote pastures. But the location at an artificial insemination centre of a beef bull of suitable breed would be desirable in certain areas. Such bulls could be used to inseminate cows of beef type and those not considered suitable for breeding dairy replacements. For the latter purpose a bull which colour marks its calves should be used.

A National Service So far there are eight artificial insemination centres and one sub-centre in operation. These are located at Cambridge ; Reading ; Dartington Hall, Totnes ; Beccles ; Avoncroft College, Bromsgrove ; Ilminster ; Kimble ; and Lyndhurst. The sub-centre, at Guildford, obtains its supplies of semen from Reading.

As already indicated it has been decided that artificial insemination shall be developed in this country as a national service on behalf of the livestock industry and that, normally, centres shall in future be operated by producer-controlled organizations, such as the cattle breed societies, farmers' co-operative societies and the Milk Marketing Board.

It is expected that the majority of the new centres will be operated by the Milk Marketing Board, and it is probable that during the present year the Board will be licensed to establish centres in Kent, Shropshire, Devon, Carmarthen, Durham, Cheshire, Wiltshire, and the West Riding of Yorkshire. Under present conditions of labour shortage and building difficulties, progress must inevitably be slow, and it is not yet possible to say when any of these proposed centres will be ready to operate.

In selecting the areas for early development, the Central Advisory Committee are guided by the density of the cow population, the proportion of small herds and the prevalence of breeding diseases. Other centres will be established in due course, following the general policy of giving priority to those areas where the need is greatest.

Conclusion Artificial insemination as a method of breeding cattle offers considerable prospects of promoting the improvement of British live stock, provided always that due caution is observed in its development. Addressing the Council of Agriculture for England in December, 1944, the Minister said:

> "I feel strongly that though artificial insemination holds out great possibilities for the future, we must in the present state of our knowledge proceed with caution. There would be a very considerable danger in too rapid development. We cannot, therefore, expect artificial insemination to provide an immediate solution to our livestock improvement problems. In any event the shortage of qualified veterinary and other staff, the lack of suitable buildings and the difficulty of erecting new ones would limit any rapid extension of the process in the near future. I would therefore like to stress that although I have great hopes of artificial insemination in the future, it should in no way be regarded as absolving the livestock farmer from taking all practicable steps here and now to grade up his herds and thus secure that improved efficiency in the production of milk and meat upon which the future of the livestock industry depends."

Although it is expected that artificial insemination facilities will ultimately be available to the majority of cattle breeders, it will still be necessary to breed bulls and to use them, especially for beef herds, in the natural way.

FARMYARD MANURE–II

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Part I of this article appeared in last month's issue of this Journal.

FIRST-CLASS farmyard manure, with all the urine saved, is best made in covered yards and loose sheds and boxes. Constant treading by the animals consolidates the mass and thereby appreciably lessens the loss of nitrogen into the air. In most parts of Britain, it is preferable to have the yard completely covered but so arranged that the south side gets the sun. In dry areas, and where there is an abundance of straw, it need be only partly covered. Where large quantities of straw are available, there is a possibility that too much may be used and the manure become too dry, so preventing proper rotting. On the other hand, where the land is all grass and no straw or other litter is available, the covered or partly covered yard is not suitable.

A cartway through the centre of the yard, or between two yards, for the passage of food and manure is a great convenience. Mangers and racks can be arranged along the sides of this feeding passage, and water-troughs arranged to serve the various divisions of the yard. Where farmyard manure is usually applied in the autumn, it is best left in the yard all the summer.

Horse Manure Young horses are often wintered in strawyards when there is no suitable grassland available, and in East Anglia, particularly, working horses also are often kept in yards. The danger of their injuring one another is small, no labour is required for cleaning out the stables, and where the yards are wholly or partly covered, the urine will be absorbed by the straw with little loss. Where, as in many parts of England, working horses are wintered in stables, the manure is best thrown out into an adjoining covered yard, unabsorbed urine draining into it. Trampling by the animals prevents excessive heating —a condition to which horse manure is particularly liable.

Pig Manure Nearly all the 3,000 pigs kept before the war on the farm of one of the writers were housed in covered buildings. A wide feeding passage runs down the centre of the building, on either side of which are the enclosures in which the pigs sleep on a raised bed covered with clean straw. Over this bed in each enclosure is a wooden roof about 5 ft. high. In cold weather a warm sleeping place, free from draughts, is secured by hanging old bags at the sides, so that there is virtually a pig-sty with a run attached inside a covered building.

The manure accumulates in the lower part of each pen to a depth of 2–3 ft. before it is cleaned out. This is carted directly on to the land whenever possible and ploughed in, so that the only loss which takes place is probably a little nitrogen into the air. On two of the farms where sows are kept a covered yard adjoins the pig-yard. The farrowing pens are cleaned out three or four times a week and the manure put into the covered yards in which dry sows are kept. The urine of pigs in all yards is absorbed by straw.

The considerable area of market-garden crops grown on these farms probably renders the ploughing in of farmyard manure in most months of the year easier than on the average farm. The soil, however, is mostly heavy and difficult to cart on to in winter, except in times of frost.

Poultry Manure Considerable losses of valuable ingredients often occur where large flocks of poultry are kept, especially when, as the writers have frequently seen, heaps are exposed in the open. Much of the valuable part of the manure consists of urea, which is soluble in water, so that the losses are extremely heavy. Unless it can be applied directly to the land, poultry manure is best stored in a covered dungstead. Its wet, sticky nature in winter is best remedied by using short straw, or straw chaffed to 4-in. lengths, as litter to absorb the surplus liquid. The manure can then be spread much more easily and uniformly over the land.

Poultry manure is best used for crops requiring large quantities of nitrogen, such as members of the cabbage family, mangolds or sugar beet. When used for cereals relatively small dressings per acre should be given, or the crops may receive too much nitrogen and become laid.

Cow Manure* A very large proportion of the cows kept in this country are housed in cowsheds during the winter. In these buildings the cows often spend twenty hours or more out of the twenty-four. On some farms they do not leave the cowshed at all during the winter. To milk cows in the same building in which they spend most of their time seems to be a most unsatisfactory arrangement. Some of the cowsheds have been "modernized"—an expression which may be taken to mean

* This section has been contributed solely by Mr. Oldershaw.

a building with plenty of width, air space, light and ventilation, a concrete floor easily washed down, washable walls, partitions and mangers easily kept clean, and very often fitted with water bowls. Even before the war, such a cowshed often cost £20 to £25 per cow. In many both ancient and "modern" cowsheds the solid manure is carted from the shed and made into a heap exposed to all weathers. Any liquid manure unabsorbed by the litter drains from the cowshed and is frequently wasted. The loss due to "washing out" by rain is particularly heavy in districts of high rainfall.

COVERED DUNGSTEADS The problem of utilizing existing buildings in such a way as to reduce this loss to the lowest point is very difficult. Covered dungsteads can, with advantage, be used for the manure from all classes of stock where covered yards are not available. The problem has been dealt with in a practical way on the farm of Mr. Dunn of Arbor Low (the Derbyshire "Stonehenge"), Bakewell. The arrangements were designed by Mr. H. E. Wells, at that time District Agricultural Organizer for Derbyshire (now Executive Officer for Staffordshire).

Mr. Dunn's cowshed is on the side of a hill, and the manure is wheeled by hand-barrow down a concrete path to a covered dungstead a little lower down the hill. The manure is emptied through an opening into the dungstead on the higher level, and is removed by backing carts to an opening at the lower level. Owing to the high altitude of the farm, very little corn is grown and, in consequence, little straw is available for litter; most of the manure therefore consists of actual dung. This makes it more suitable for spreading on grassland, since there is little long material to contend with. The roof over the dungstead prevents washing out by rain water (the district is one of heavy rainfall), and the urine is conducted to an underground tank, from which it is removed by a chain pump. Mr. Manning (District Officer, Derbyshire W.A.E.C.) informed one of the writers that straw is often chaffed for litter. Sometimes battens of straw are cut into three with a scythe blade, thus reducing the difficulty of handling long, strawy manure, which is especially troublesome where the manure is applied to mowing grass. Mr. Dunn has applied liquid manure to grass after rain for the past sixteen years with very good results; he does not find that it harms the clover. If used in dry weather liquid manure will burn the herbage. He also used it with good results on land intended for cabbage.

To distribute the liquid Mr. Dunn made a watertight wooden box of 1-in. thick wood and fitted it with iron bands. This box is 3 ft. high and is fitted into an ordinary farm cart. There is a funnel on top, and the liquid runs into a wooden box spreader through a large tap fixed at the bottom. The floor of the box spreader is perforated with 1-in. diameter holes, and is held in position by two chains attached to the cart.

It would appear that the manure from most of the existing cowsheds in this country can best be dealt with by the provision of a covered dungstead, which can also be used for the manure from other animals. The sanitary authorities will probably insist that this dungstead must be at some fair distance from the cowshed. It should have a concrete floor without drainage, and should be so arranged that the solid manure from the cowshed can be put in at one end and removed by carts from the other—if possible, at a lower level. The wastage of urine in cowsheds can be prevented only by its absorption in litter (a difficult matter) or by collecting it in a liquid manure tank. An electric pump greatly reduces the labour of emptying the tank.

COVERED YARDS Existing cowsheds—many of which were built or modernized between the two great wars—will probably have to be used for a very long time, but whenever new methods of housing cows come under consideration, construction should aim at securing healthy cows, pure milk and good manure, with the minimum of labour. Where cows cannot be wintered out-of-doors, wholly or partly covered yards open on the south side, and in which the cows sleep, seem to offer important advantages. Rationing of bulky foods is probably best done by dividing the yard into separate compartments to hold no more than 12 cows, so that they may be grouped roughly according to their milk yields. Similarly, horning may largely be prevented by segregating the quarrelsome cows and by dividing the yard into enclosures.

Mr. R. G. Salter in the May, 1943, issue of the *Worcestershire Agricultural Chronicle* describes a method whereby a small milking-shed or "parlour" is provided, having room in it for only a few cows at a time. Each cow spends very little time in this shed, so that it is easily kept clean. Nearly all the manure is made in the covered yard and, in consequence, the very heavy work of "mucking out" every day is obviated. Mr. Cecil Amos of Glebe Farm, Costock, Nottinghamshire, estimates that to "muck out" 12 cows and wheel the manure to a dungstead 20 yards away and pile it up, takes one man one hour daily all through the winter. Against this, of course, the extra time taken to transfer the cows from the yard to the milking-shed has to be considered.

Given plenty of litter, the cows are much more comfortable and probably more healthy in yards than tied up all the winter. Gates, feeding-troughs, etc., should be so arranged that they can be raised as the manure rises.

Three Examples Mr. John Rush, Junr., of Tannington, Suffolk, has recently provided a covered yard, 60 ft. × 30 ft., with concrete walls of 2 ft. 6 in., in which his 20 cows now spend most of their time, partly to conserve the liquid manure (previously wasted) and partly because he considers that the cows are much more healthy walking about in a covered yard than tied up in a cowshed. He now uses the cowshed only for milking and for feeding concentrated foods. Wood from the farms was used in constructing the covered yard, and the floor is of chalk. Water is laid on and long fodder is fed there ; also roots when the weather does not permit a run on to a meadow. A concrete path, 22 ft. long, connects the yard and the cowshed, and the south end of the yard is open to the sun. A space of 1 ft. below the eaves allows plenty of ventilation. The total cost including labour (which came from the farm) was £150.

If manure is to be allowed to accumulate to any considerable depth, plenty of head room must be allowed in constructing covered yards. Mr. Rush thinks that it is better not to allow more than 3 ft. of manure to accumulate under the cows ; hence the covered yard is cleaned out once during the winter and the dung heaped in a field where it will be required. A second lot of manure produced in the winter is left in the shed until the autumn. All the urine voided in the covered yard is absorbed by the straw. The cowshed is washed down daily, the udders and hind-quarters of cows are washed, and accredited milk is produced. Mr. Rush thinks that it would be sufficient to have milking space for one-quarter of the total number of cows in the cowshed.

Leicestershire W.A.E.C. has in occupation the Old Manor Farm, Little Dalby, and on this farm the owner has, with the advice of the Committee staff, recently erected covered yards and a milking-parlour for 48 cows. Two covered yards, 10 yd. × 14 yd., each section holding 12

cows, are separated by an uncovered concrete path wide enough to take a cart. The concrete floors of the yards are 2 ft. below ground-level and undrained. The gates and doors are on hinges and can be raised when the manure accumulates. Fresh air gains access to the yards through large open spaces in the walls. Open air gangways lead to the washing-down room and milking-parlour, the distance from the latter to the yards being 12 yd. A T.T. attested herd of Ayrshires is kept. The tips of the cows' horns are cut off to reduce "horning"; and the calves are now being dehorned. When the herd was started all the cows were strange to each other, but no serious damage from horning has resulted. The cows spend most of their time in the covered yards in winter, and all the dung and urine voided go to produce farmyard manure. The concentrated foods are fed when the cows are milked.

On Lord Cranworth's home farm at Grundisburgh Hall, much experience has been gained regarding the production of manure from an accredited herd. Mr. Taylor, Lord Cranworth's agent, thinks that it is sufficient to have a milking-shed for one-third of the total number of cows. The latter spend most of their time in covered yards facing south and open to the sun. At Elm Tree Farm, Grundisburgh, the yards are too near the milking-shed, and this means that to satisfy the sanitary authorities the manure has to be removed and heaped in the field, thus involving great waste of valuable ingredients. Provided the yards are far enough away from the milking-shed, the winter's manure can be left undisturbed until the following autumn.

The rationing of bulky, as well as concentrated, foods is considered important, and it has been found that heavy milking cows, receiving a lot of concentrated food, fill themselves with hay and straw and then fall off in their milk. The remedy seems to be to divide the yard into four parts or so, and contrive rationing of bulk by putting the heavy milking cows together and giving them less hay and more concentrates. Several loose boxes for calving are very useful. Seven- to eight-gallon cows should not be allowed to eat straw, and it is, therefore, well worth while to keep them separate.

Manure from Other Cattle Store and fattening cattle, sometimes with pigs running amongst them, are very suitably kept in covered or partly covered yards, and most excellent manure is produced in this way. The difficulty of preventing waste with these classes of animals is very much less than with cows. If they are kept in covered yards or loose boxes, and the manure left *in situ* until carted on to the land and ploughed in, the only loss which is likely to occur is a little nitrogen into the air.

Summary At present manure produced from milking cows is, in the large majority of cases, subject to enormous waste. Very often the solid manure is stored in rough heaps in the open, where its valuable nutrients are washed out by rain and the urine is entirely wasted.

"Modern" cowsheds, which to meet present-day views on the production of clean milk are washed out daily, the liquid going down the drain, probably increase this waste of fertilizing material.

Where cows are confined in cowsheds during the winter, the most satisfactory way of conserving the valuable ingredients of the manure seems to be:

1. A covered dungstead for the solid manure at a fair distance from the cowshed—say 20–40 yd.
2. A liquid manure tank for the urine, with a two-way arrangement whereby the urine is conducted into the liquid manure tank and the washing water goes down the drain.

There is evidence that cowsheds are not the best or most healthy places in which to house cows during the winter, and that a better arrangement is to have covered yards in which they can spend most of their time, and small milking-parlours which can be kept scrupulously clean and are used only for milking and feeding concentrated foods.

In this way most of the manure is made in the covered yards and the urine is absorbed by the straw. If this manure can be carted on to the land and ploughed under at once, comparatively little loss of fertilizing material will occur.

HAYMAKING IN THE BARN

THE best hay is that which has been cut young and afterwards preserved with all its parts and its natural green colour as far as possible intact. For this it is necessary to safeguard the crop from undue exposure to sun or rain and to prevent fermentation in the stack. The ideal method is artificial drying by heated air. Since this is not generally practicable, attempts have been made by other and less costly means to effect at least some improvement of existing methods. It would, for instance, be helpful to shorten the usual interval between cutting and carting—the time when the greatest losses commonly occur.

Baling in the field and the use of salt in the stack offer a partial solution only; they do not satisfy the need for a method that will materially hasten drying without incurring heavy expenditure on specialized plant, or requiring more labour or machinery than that usually employed on the smaller farms.

Briefly, the problem is to reduce quickly and cheaply the moisture content of freshly cut grass from approximately 75 per cent. to not more than 20 per cent., the level at which storage can safely be undertaken.

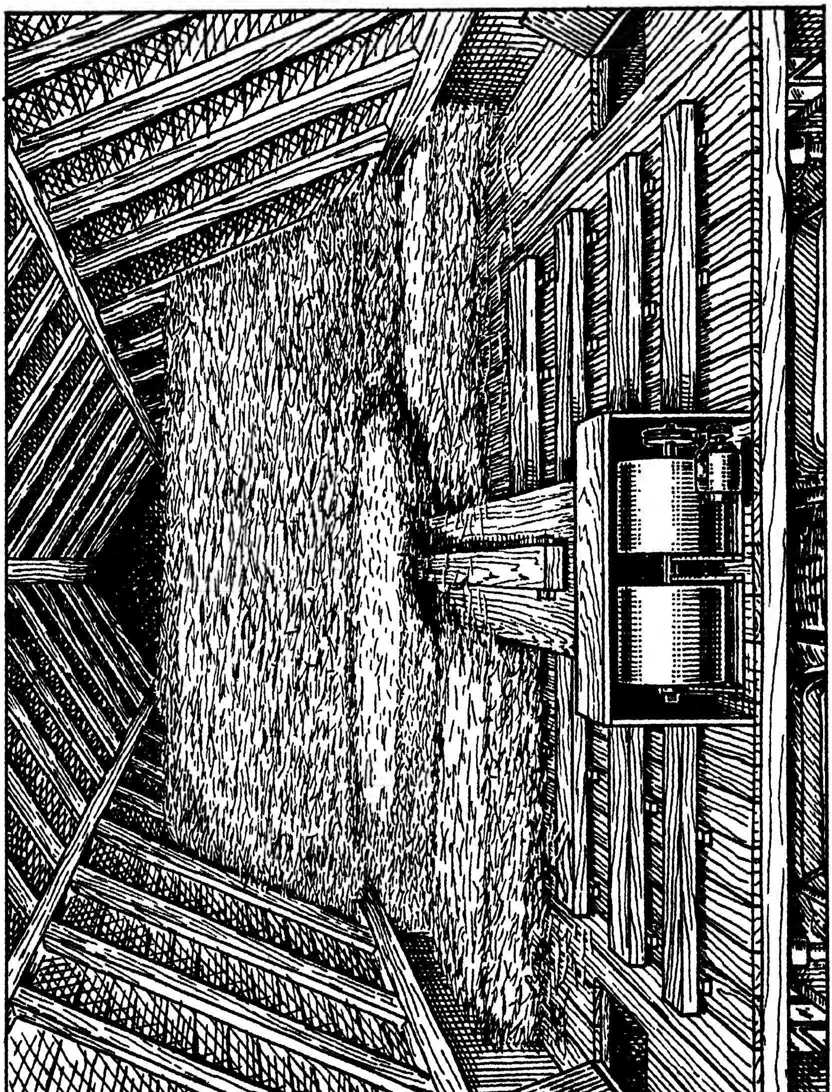
American Practice Investigations have been carried out in this country and elsewhere for many years, but the most recent advances appear to have been made in the U.S.A., principally in those States where the annual rainfall is high and wet conditions frequently cause difficulties and losses at the time of haymaking.

Early attempts to dry freshly cut grass (usually by passing currents of heated air through small or large stacks) proved unsuccessful, but the practical and technical knowledge gained in the course of these experiments be allowed to eat straw, and it is, therefore, well worth while to keep led to the "barn hay-drying system," which was first tried out in Tennessee in 1935. The system is based upon observations that on a normal sunny day the moisture content of freshly cut grass falls from 75 per cent. to as low as 45 per cent. within four or five hours of cutting. After this initial drying in the field the grass is carted to the hay barn, where the making is completed under cover.

The plant consists of an electrically driven blower which forces air into a main duct branching into lateral ducts laid down about 4 or 5 ft. apart on the barn floor (see illustration overleaf). Spaces under the lateral ducts allow the forced air to escape. The floor of the barn—usually over the cowshed—must be airtight. (Building paper has been used successfully on unsuitable floors.)

The field-dried grass is stacked evenly over the barn floor and within 4 to 14 days, depending upon atmospheric conditions, is made into a green, leafy hay. The limit of stacking appears to be 6 ft., but a second and third layer may be added after the first layer has been "made". The maximum height after settling is said to be 10 ft.

HAYMAKING IN THE BARN



With acknowledgments to the *Virginia Polytechnic Institute Blacksburg, Virginia.*

Though the process demands attention to humidity as well as temperature, the rules of operation are simple. The blower is shut off at night except for one period of about 30 minutes. In all observed experiments the temperature never rose above 138° F. Automatic controls can be installed to regulate the temperature in relation to the varying degree of humidity in the atmosphere.

Costs The costs of installation in the U.S.A. in 1939 were approximately 300 dollars (£75) for a plant capable of producing 20 tons of dried hay, and 400 dollars (£100) for a 30-ton plant. On some farms the hay was moved out of the barn after drying, thus enabling a 20-ton plant to produce 40 or 60 tons of dried hay, and a 30-ton plant to give up to 90 tons. The average cost of drying was 86 cents. (4s. 2d.) per ton of dried hay.

Labour costs were considered to be the same as those incurred under the ordinary system of haymaking. Storing hay evenly on the barn-drier required more labour than normal stacking, but this was generally offset by the increased demands made under the older method as soon as unfavourable weather occurred.

Hay dried under the barn system is considered to be one grade better than hay made in the field. The chief advantages claimed are that there is little risk of excessive damage through weathering and no risk of complete loss.

Some such method as this might, conceivably, be adapted for use in Dutch or other barns, or in stacks, in this country.

ON YOUR METAL

I. POWER ON THE FARM

Clyde Higgs with Roland Dudley of Linkenholt Manor, Andover, and E. Rea of Messrs. R. A. Lister and Co., Dursley, Glos. (*B.B.C. Home Service, January* 11, 1945)

"FROM an acre a day with oxen to an acre an hour with a modern tractor is about the measure of our increased mechanical efficiency during the past hundred years." Thus Mr. Clyde Higgs introducing the new B.B.C. series of discussions, *On Your Metal*. In the time at their disposal he said they could not deal with all the problems of farm machinery; only with the seasonal use of it in relation to mixed farming.

Power on the Farm Mr. Dudley, a pioneer of mechanized farming, said that the power unit was based on the tractor, which must be kept working as far as possible to its full capacity. It must be of a type suited to soil and situation—a track-layer for operating on chalk hills such as he is farming, and a wheel tractor for transport, with horses for the shorter distances. At this point Mr. Rea mentioned that in America the track-layer was dying out; 93 per cent. of the tractors in America, he said, are wheel types, over half being row-crop. For the average farm—about 120 acres—ploughing is a comparatively small item in the year's work; the greatest need is for a dual-purpose tractor to supplement horse work. The others agreed, although Dudley qualified his assent by suggesting that the smaller man might get his ploughing done by contract or by co-operatively-owned track-layers.

To the question whether any guidance could be given to the average farmer as to when a tractor is justified, Dudley submitted the following tests: will the machine increase output sufficiently, or will it save a man's wages? "And," added Rea, "enable the man to do another job." Higgs agreed that there must be another job waiting, "a job that another machine can't do . . . preferably another machine to look after."

As to the ideal power unit for the small farm, he would like to see a low-priced tractor, preferably with a Diesel engine, that would be cheap to run, and get over the bugbear of idling. Machines must be designed for British conditions, including the small fields with their surrounding hedges. Mechanization must not be carried to a stage where it conflicts with the interest of live stock. Dudley agreed. It is unwise on principle to make farms suit machinery. Before starting to play about with hedges he would tackle the problem of lanes and gateways. "If," he said, "you can get a large output from your land, whatever it is, you can afford more mechanization." Higgs was inclined to think that we are not applying the machines we have so as to get full output. With large machines co-operatively-owned, as Dudley had suggested, we might be able to get over more work with smaller numbers.

Rea did not think that many people deliberately locked up capital. The need for doing a job well at the right time justifies the machine, and in private ownership wear and tear would be relatively low. He would reckon one tractor to about 100 acres of arable.

Higgs. "Say the unit cost £200, what *output* would justify that?"

Dudley. "Well, whatever will provide sufficient revenue to pay off interest on the capital and depreciation on the tractor and implements.'

Depreciation allowances, Dudley thought, are far too low. It is ridiculous to be allowed to write off only 10 per cent. on say a harrow or cultivator which would not last for more than a few years. For efficiency it is necessary to be able to replace worn-out implements. Another point, he added, is that with changing methods it is necessary to keep changing machines. "Obsolete equipment decreases revenue."

Mechanization demands Management Higgs then drew a distinction between power-farming and power on the farm. They were really discussing the latter, and in this connexion management *for* machinery is just as important as management *of* machinery. Rea said that the working of the holding must be arranged so as to give a compact arable area, since nothing wastes machinery more than unconnected fields. It is also important, he continued, to keep similar crops together and to spread the peak load by growing different varieties. "A mile on the road loosens more nuts than a day in the field." (*He did not, however, quite manage to reconcile this line of argument with ley farming and taking the plough round the farm*—Editor.)

Higgs then returned to the question of co-operation as a means of reducing the cost of ploughing on small farms. What are the snags? Dudley thought leadership and the tendency for the man with the biggest share to insist on his work being done first. To counter this, Rea would favour the contract system, but Higgs thought that in practice the contract system works no more fairly than co-operation. Even with such a job as threshing, for which timing is less important than for harvesting, there are great advantages in having one's own drum.

Men and Machines Higgs then directed the discussion to the question of labour—quality and quantity. Complicated machinery calls for a class of labour difficult to get, and when all the various

operations were speeded up where were they going to put the farm workers returned from the Forces, and the others who were reading about farming ?

"What about it, Dudley ? You had reduced labour to a minimum before the war, hadn't you ? "

Dudley. "No, sir. I had increased my labour by using machinery."

Whenever Dudley put on a machine he had to employ two more men, either to handle the output or to do jobs best suited to manual labour—intensive live stock, for example. There is no need, he said, to trouble about the labour position provided there is an economic price for the output.

Higgs also believes that we have had rather too much bread and potatoes and that we could do with more meat and milk, but finds that stock are a constant check on the full use of power. Week-end milking, for instance, said Rea. This, however, does not baulk Higgs with his machine milking; but Dudley hinted that with the cows out winter and summer on the "bail" Higgs might be failing to develop the potential power of his dairy ! Still, no doubt it pays. He himself had been very satisfied with the folding of pigs and poultry in conjunction with corn production before the war.

Higgs then solicited views on milking machines. Rea would like to see a cheaper and simpler machine for the smaller herds, a substitute for tinning, and a low-cost cooling plant.

Repairs and Standardization The next question related to repairs and standardization. Rea said that manufacturers and service agents all agreed that many repairs could be avoided by more care and attention to minor breakages. "The manufacturer's best salesman is unpaid and works 24 hours a day . . . I mean rust." There are three cardinal points: clean the machine, lubricate it, and protect it from the weather.

It was generally agreed that more sheds for machinery and implements are required, and that for large farms a whole-time mechanic should be employed. For the rest the local smithy should be brought up to date to form "a proper little engineering works," with acetylene welding plant, a drilling machine, power hacksaw and a screw-cutting lathe. Dudley thought that such shops would provide interesting occupations for a lot of young fellows who will insist on working with machinery. On the question of standardization, he pleaded vigorously for the standardization of the common parts, knives, shares, etc., not of designs as manufacturers seemed to think whenever the subject was broached. At the same time he did not think it necessary to have a different plough for every district in the Kingdom.

It was generally agreed that standardization would benefit everybody: the manufacturer through reduction of overheads and handling costs; the service agent because he could concentrate his capital on fewer lines; and the farmer by quicker and cheaper service.

II. SPRING: CULTIVATING TOOLS

Clyde Higgs with Cornelius Davies of the Ministry of Agriculture and John Mackie of Bent, Laurencekirk, Kincardineshire (B.B.C. Home Service, January 25, 1945)

THE second discussion in this series opened with an exchange of views on the preparation of a seedbed. Mr. Higgs said that the present basis of cultivation, as for hundreds of years past, is the plough. He disagreed with views recently put forward in an American book that the plough could be dispensed with.

The Plough Mr. Mackie, who farms in a big way in Kincardineshire, said that whether you are ploughing for potatoes, where a deep seedbed is essential, or for corn, correct ploughing assists all later cultivations. In Scotland there is not the same obsession as formerly with sharp, well set-up furrows, but many farmers strongly favour deep ploughing, using both semi-digger and full-digger ploughs—8 to 9 inches for grain and 9 to 14 inches for roots and potatoes. There are still farmers who like to see their fields as if a ploughing match had been held there, forgetting that pretty, unbroken furrows have to be broken up later. With the digger plough the furrow is broken and half the cultivation done straight away.

On clay land Mr. Davies does not favour the breaking of furrows that are to lie over the winter. Broken soil gets sodden and cloggy. Mackie disagreed as regards Scotland, but then, as Higgs pointed out, he doesn't know Warwickshire clays "that pull one's boots off". Would he suggest that men with one tractor should have more than one type of plough?

Mackie thought that for loamy soil one type—a semi-digger—would be enough.

On the question of deep ploughing, as for potatoes, he said depth was a necessary preliminary for proper rooting and summer cultivations. With sugar beet he would prefer to plough a moderate depth and sub-soil below that. Davies said that deep ploughing was a good thing on certain soils and for particular crops, but as a general rule why not merely stir up the subsoil, particularly on clay land? Personally, he favours the long mouldboard for heavy soil, the semi-digger for the loams, and the deep digger for special conditions and market-garden crops.

The Plough Load Higgs then broached the question of the plough load. The general use of a three-furrow plough behind a medium-power tractor is advocated in official quarters, but on occasions only two furrows are possible—involving a heavy lock-up of capital if two ploughs have to be purchased. Mackie would convert a three-furrow to a two-furrow plough when this is necessary, but Davies thought it would take longer to effect the change-over than to get on with the job of ploughing. A two-furrow plough was rarely necessary. On average land each furrow needs 5 horse-power. The majority of tractors develop at least 15 drawbar horse-power. Medium-power tracklayers will do four furrows, and the bigger ones five or six furrows.

Cultivation Tools The next question related to tools for breaking the soil down after ploughing. Davies thought the first to be considered was the disc harrow. Mackie thought "the weather" earned pride of place. Agreed. But why is the disc so popular? Davies thought the explanation to lie in the war-time ploughing of old turf and the fact that the disc consolidates without bringing up trash.

In Scotland, Mackie said, drilling commonly follows digger ploughing without any discing or even harrowing.

Higgs: "But are we satisfied with our discs as implements?"

Mackie: "No. I think most discs are far too light. . . . If we are going to substitute ploughing with the semi-digger and discing for deep tined cultivation . . . the only disc worth using is the heaviest pattern with a track-layer."

He thought narrower, heavier discs—no wider than the tractor—would be an advantage. Probably half the farmers in Scotland do not possess a modern cultivator.

Higgs: "Then what do they do when they want a fallow?"

Mackie: "We don't fallow land in Scotland. We can't afford to."

Higgs and Davies, however, are both satisfied that a fallow is an absolute necessity on many English clays, and that a cultivator is appropriate in such circumstances.

Asked whether he did much stubble cleaning in Scotland, Mackie replied that they never seem to get the weather nor the time, and if the corn is thick enough it keeps the weeds down. To this end he cross-drills with a disc sower, which gives a wider distribution and at the same time improves the tilth.

Higgs: "It's supposed to fox the wireworm also. He walks up the land nibbling the shoots, then comes to a cross-roads and doesn't know which turning to take!"

Mackie is not troubled with wireworms. "You see we'd let very little of our land back into old grass."

Davies said that so far as wireworms are concerned the soil must be knocked about with cultivators, discs and rollers, to get good consolidation.

Asked about the rolls used in Scotland, Mackie said the smooth type is by far the commonest. As clod crushers both Higgs and Davies favour the Cambridge type; the smooth roller is generally too light. Some of our road blocks would do the job well. Rolling, to be really effective, especially against wireworm, said Higgs, has to be heavy and slow. He added that one of his perennial grouses about rolls, discs and other field implements is their bearings; why can't they be dirt proof? Expense, said Davies.

Drills Next, corn and fertilizer drills. Davies thought the small mixed farmer wants a "plain" not a "combine" drill. The latter is costly and has not yet proved itself, he said. Mackie would have agreed with Davies a year or two ago, but not now. He used a combine for the first time last year and is delighted with it.

Higgs: "I hope you cleaned it out, Mackie, when you finished with it."

Mackie: "I'm sorry to say we haven't yet."

While wishing him luck next time he used it, Higgs expressed the view that the farmer wanted a much less expensive drill, a general-purpose one that will sow everything from beans to grass seeds. The trouble with a combine, as with a manure distributor, he said, is maintenance. Davies agreed, adding that eleven or thirteen rows with discs or, for stony ground, coulters, are sufficient. He would use a higher gear if the tractor were underloaded, and attach a set of covering harrows.

Asked if he thought drills should have a self-lift, Mackie said it was necessary on big drills but a luxury on small ones. There should always be a man on the drill to make sure that the spouts are all running. Unfortunately, he added, on many drills a man cannot see the grain running.

Davies prefers the force- to the cup-feed mechanism, and is not sure that with combines the fertilizer is wanted down the same spout as the seed. Further, not all fertilizers can be used with a combine.

Higgs uses ammonium phosphate, but thinks that the combine will be threatened "if ever we get a decent manure distributor". Mackie agreed up to a point: a decent manure distributor, he said, would be one carried behind a tractor trailer with enough fertilizer to do half a day's sowing at the rate of 1 cwt. to 2 tons per acre. There are centrifugal distributors of this kind, good for lime but not artificials; the wind has too much effect on them.

The trouble, said Higgs, is that fertilizers vary in texture from day to day according to the weather. He will, nevertheless, continue to use his combine so long as fertilizers are short.

RURAL HOME-MAKING IN NEW ENGLAND

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Miss Strang was one of a party of four agriculturists who, at the invitation of the U.S.A., visited N. America last autumn on a lecture tour. Her account of rural home-making in New England will be read with wide interest.

DURING my recent visit to America I spent a considerable part of my time in the New England States, and I have been asked to contribute some observations on that part of the country, particularly regarding rural life from the angle of home economics. My remarks apply only to the places which I visited, and should not be looked upon as typical of America as a whole.

There are many ideas which although practicable in America would be either unnecessary or unsuitable for our conditions. If the matter is probed sufficiently, one often finds that there is some fundamental reason for differences in practice in the two countries. Nevertheless, each country has something to learn from the other.

With their newer country, the Americans when building their homes were able to embody many new ideas, whereas older countries have had to make do and adapt as circumstances permitted. Over there they build with rather less permanency than we do. They attach less importance to tradition, and as they would tell you, they do not hesitate to sweep away the obsolete to facilitate progress and efficiency. In other words, they would not hesitate to pull down what they consider an out-of-date house and build a modern and more convenient one in its place.

Labour Saving in the Home Few American middle-class homes, even in pre-war days, had any domestic help—not even a daily woman. The housewife has always had to do most of the household chores herself, with perhaps some assistance from her husband and family. It is not surprising, therefore, that a great deal of thought has been put into saving unnecessary effort in the home. The general lay-out and labour-saving devices of the American kitchen are specially noteworthy. Electricity, although still not available on some of the more remote farms, is in fairly general use in most rural areas. It plays an important part in the household economy, since it is used to run many of the labour-saving devices. In addition to lighting and cooking, it is used, among other things, to run the clothes-washing machine, the iron, the vacuum cleaner, the floor polisher and last, but by no means least important, the refrigerator. A refrigerator is looked upon not as a luxury but as a *necessity*. This is due partly to the warmer weather which they have in summer and their greater difficulties in storing food. Nevertheless, it seems to me that when times become normal, the more extensive use of refrigerators in many of the smaller homes in this country would add greatly to the conveniences of housekeeping and at the same time prevent a considerable waste of perishable food.

It is true that many of the electrical appliances to which I have referred are used in this country, but they are apt to be looked upon as luxuries, and apart from lighting and heating are not found to any great extent in working-class rural homes.

The arrangement of kitchen fittings is significant. There is no stereotyped design, but the aim seems to be to have everything to hand, in a

place of its own, and easily accessible; for example, a cutlery drawer would be divided up, so that there would be a separate compartment for each size and type of knife, fork and spoon; drawers for kitchen utensils and linen are partitioned in the same way. Cupboard shelves are arranged so that every article can be got at without lifting out another. The shelves are movable and adjustable. A narrow shelf might be fitted into what would otherwise be waste space, between two wide shelves, and the narrow one used to take the small crockery, such as cups or soup bowls. There would be vertical or upright partitions to take trays, serving plates, and the larger flat utensils.

A food cupboard would have deep, tin-lined drawers divided into compartments for (say) fruit, bread, flour, cakes, etc. In fact, infinite thought is given to the smallest detail in arrangement.

Study of Home Economics The Home Economics Departments of the Universities and State Colleges devote a great deal of time and attention to what they describe as "Home-making". They employ specialists to carry out research in the different branches of this subject and, through their Home Demonstration Agents, disseminate information by means of talks and demonstrations to groups of rural women.

The aim of the "Home-making" departments is to develop home and community life, to make the housewife realize that she has an important part to play in the life of the home, also in utilizing home-produced food, and in buying wisely whatever may be needed to supplement it. In short, to give her a sense of importance, as well as an interest in the job she is doing.

Home-making covers a wide range of subjects. In addition to foods and nutrition, clothing, household management, reconditioning old furniture, and planning the kitchen, it deals with psychology and human relationships. "Community Projects" cover markets, health, recreation, public welfare and so on. Advice is given to individuals as well as to groups on all these subjects.

Ice Lockers On the subject of Community Projects, there is one thing which I think we might copy from America with advantage, that is, their Community Ice Locker plants. These plants are becoming increasingly popular. I was told that there are now some 4,500 of them in the States. They are situated in convenient centres, not only in cities, but also in the smaller country towns. Ice-Locker or Frozen Food Plants should not be confused with household refrigerators. The household "frig" usually runs at a temperature of 40°–50° F. Science tells us that as temperature decreases, the development of harmful bacteria in food is retarded. A temperature of 40°–50° F., while adding greatly to the keeping quality of food, will not preserve it indefinitely. It is for more or less indefinite storage that the freezing plants are used. In most cases they are run at a temperature of 0° F., although there may be provision for still lower temperatures for quick freezing prior to storing.

The ideal arrangement would be to have a freezing cabinet in the home, but the cost of running the plant at such a low temperature puts it outside the reach of the average householder. Home freezing cabinets are, however, used in a few well-to-do homes. "Community Freezing Plants," on the other hand, though costly units to set up, are much more common, and by paying 12–15 dollars a year a householder can rent a

"Community Locker" ordinarily of about 6 cubic feet capacity. She is provided with a key, and keeps everything locked up, so that she is the only person who has access to it.

It is claimed that the nutritional value of food stored in this way is almost unchanged—in fact it is considerably higher than where food has been preserved by canning or bottling. Fresh food put into an ice locker in summer, without any preparation whatsoever apart from wrapping it, will keep quite well for winter use. Any surplus of in-season foods can be stored for out-of-season use. The sort of foods which could be preserved in this way in this country are green peas, beans, asparagus, raspberries, strawberries, cherries, game, poultry and turkeys.

One "Community Plant" which I visited had a slaughter house attached, and the owner did the slaughtering of animals and the dressing of the carcasses. A special charge was of course made for this extra service, but it did not appear to be excessive, and any meat surplus to immediate requirements was stored at the plant, and might be used over a period of perhaps 6 to 12 months.

Domestic Preservation I cannot leave my observations on the domestic side without a brief reference to bottling, or "canning" as they call it in New England—incidentally it is always glass bottles which are used. I do not remember visiting a single rural home without seeing a store of home-bottled fruit and vegetables for winter use. Every rural woman seemed to do bottling, and it was not just a few odd bottles; often there would be as many as 200–300, both of fruit and vegetables, in the store cupboard for one family. Americans have, of course, an advantage in the greater variety of fruit available to them; these include peaches, grapes and nectarines, in addition to the more common kinds, but I noticed that there were usually a good many bottles of tomatoes. These would be used either as a base for soups or might be fried with some of the home-cured bacon.

Labour Saving in Farm Buildings And now I should explain that although I have been asked to deal with rural life in New England from the woman's angle, I am not a technical expert on this subject. While I was naturally anxious to see what I could in this sphere, my principal concern is farming, particularly dairy farming and poultry-keeping. Here I would just like to say that it seemed to me the Americans apply very effectively the same sort of principles to the planning and lay-out of their farm buildings as they do to their houses. Labour-saving is considered first and all the time. For example, their cowsheds, or "cow-barns" as they call them, are almost invariably built with a hay loft overhead and a silo at one end. Also, there is nearly always a feeding passage in front of the cows. Indeed, feeding passages seem to be regarded as the right thing in all buildings in which stock are kept. By their use time is saved, and it is possible to carry out the ordinary routine duties of feeding stock with far less effort and in greater comfort. Where electricity is used for lighting and power, the working day can be lengthened considerably and more effective use can be made of the available man-power, which, incidentally, is very scarce.

WOMEN IN AGRICULTURE

FRANCES DONALDSON

(Author of *Approach to Farming*)

WITH peace just over the horizon, it becomes relevant and profitable to discuss the future of those occupational innovations and movements of population which have occurred during the war and as a direct result of it. Of these, few are more important or interesting than the position of women on the land.

In the first place, the question whether they can, in emergency, be usefully employed on the land in large numbers is not open to doubt. The absolutely vital contribution which they have made to the production of food during the war is too well known and too well understood to need emphasis. But this does not of itself affect their future position in the industry. The best way to arrive at some estimate of their future potentialities is to attempt to assess qualitatively as well as quantitatively what their contribution has been. Since I am not in possession of any statistical information on the subject (as far as I know there is none), I can only review the matter in the light of my own experience and opinions as a farmer, an employer of female labour, and as a female worker on the land.

Because there is always likely to be a considerable difference in conditions of life and in scope for ambition between the farmer, on however small a holding, and the farm worker, I think it is wise to consider them separately. Since, no matter what the systems under which we farm in the future, the farm hand working for a wage must form by far the largest group in the agricultural population, it is proper to give him first consideration.

The Physical Handicap I know girls who can plough with tractor or horse as well as a man, who can start a tractor from cold, who have replaced experienced cowmen ; I know at least one girl who can plough, stack, thatch, lay a hedge, shear sheep and milk a cow ; another who has been shepherding ewes single handed on the Warwickshire clays for the last two seasons ; others who have run a milking bail ; and one who has managed 300 acres of land in Suffolk with complete success during the greater part of the war ; many who are running small holdings ; of others who have replaced pigmen, taking on all the work of castrating, ear-marking, etc. ; of still more who have been of immense value in the less responsible jobs in the cowshed. No one can deny that these girls will always be able to find a place for themselves in a healthy and prosperous agriculture. But I am convinced that they are the exceptions.

Women, on the whole, lack the one absolutely essential quality for every skilled job on a farm—strength. It is useless to know how to set a plough if you lack the physical strength to turn a rusted bolt ; impossible to build a stack if, while knowing full well what should be done, you cannot sustain the speed at which the work must be done ; hopeless to attempt to shear sheep if you cannot catch and turn a fat ewe ; difficult even to milk a kicking cow if your weight and strength, when set against her, are too slight to confine her smallest movement. Unfortunately in farming the skilled jobs, more than almost all the unskilled jobs, require strength. And so women, who are not lacking in intelligence, conscientiousness, initiative, who are not ungenerous of their time, enthusiasm and love, may be set to do routine jobs which require for their best performance only endurance and placidity. Even here they have all too often to watch some unaspiring countryman outpace and outmatch their best and most eager efforts.

Will Farm Work Attract Women ? There are many questions to answer before one could say definitely that there will be a real place for women in agriculture after the war. But the first of these must be: will they want to work on the land? If the answer to this is "No," then it is idle to question any further. I believe that the large majority of women would return such an answer.

I have had too many really good girls on this farm since the war to be unaware of what the land does to them. This is a very hard farm, and we have always suffered from the dual disadvantage of being short of labour and of having too high a proportion of female to male labour employed on it at any time. But I think it is not unrepresentative of farms up and down the country and therefore that my experience is worth quoting from. I have found that the good type of girl usually falls into one of two categories. There is the girl who arrives firmly determined not to be beaten by anything; and, all praise to her, she is beaten by very little. She usually has to take the more interesting positions by surprise—that is, by defeating in advance the obstructive disbelief of the men in her capacity, and this she often does by a completely untutored but spirited demonstration of it. This kind of girl does not often give in, but after a while she becomes strained past bearing, nervous, short-tempered, less anxious to attempt new things. The other type of girl, more conscious of her limitations, does not attempt so much and probably stays the course better, while giving conscientious and very valuable service. But it is doubtful whether she ever reaches a standard of achievement which would satisfy an employer who had the alternative of employing a man.

It is the never-ending nature of the work on stock and the busy times—hay, harvest, hoeing—which many of the girls cannot stand. At first, while the experience is new, it rather amuses them to be always dirty, always rushed, always physically tired. But after a while it breaks their hearts to have permanently grimed hands, never to be able to get a permanent wave, to have no free time and no private life. Their endurance is probably no less than that of men, but it is fair to say that most men, when they get home, do not have to mend socks, wash out underclothes, and get their own tea. Girls on stock and girls in the busy times spend far too much of their leisure simply sleeping it off.

Thus I do not believe that after the war many women will desire to find employment on the land. I have already said that I can speak only from my own limited experience. If, two years ago, one put to land girls the question: "Do you want to stay on the land after the war? ", perhaps four out of five of them would have answered "Yes"; to-day, I am convinced that they would answer in the same proportion, "No".

Women as Farmers Relative to the numbers of either sex for whom it is possible, there may, I think, be a greater future for women as farmers. On this point I can speak from a still fairly unusual and quite definite experience, and I would say that women will fare best either on the very small holding or on the exceptionally large. On small holdings the work, as a rule, is concerned mostly with stock-rearing and tending — work for which women have an undoubted capacity and liking. Although it involves ceaseless toil, it is often of the lighter physical kind, and the ownership of stock offers certain compensations for the grimness of the life involved. On the very large holdings the job of the farmer is largely administrative and, since some women have shown undoubted administrative ability, I see no reason why they should not make as much success of it on the land as in offices. Certainly they will

meet with less surprise and more kindness and encouragement from their colleagues and competitors in the country than, I think, they would find anywhere else.

But on the medium holdings the disabilities of women again become operative, as they do in employment. The farmer on a holding of from two to three hundred acres is usually a working farmer, relying on himself not merely to manage the farm but also to provide the skilled tuition of young employees and to give the detailed instructions or correction to older, more knowledgeable men. He cannot afford to employ heads of departments or too much technical skill, and if he wants the work carried out to a high standard of efficiency he must himself be able to show the men the best way of tackling every job. This is asking too much of all but the very exceptional woman. I have been running this farm by myself for two years now, and from the viewpoint of food production I think I have little to be ashamed of, but I am not so easily satisfied as to be unaware that had I been a man with equal opportunities, I could have done a very much better job.

I would be the last person to suggest that it is impossible for women to achieve satisfaction and success in general farm work; I know that for women who are sufficiently determined it most certainly is not. But I do not believe that the number of women who will do so after the war will be statistically or socially significant.

The True Influence Nevertheless, more has been achieved by this war-time movement of women on to the land than the immediate results of their labour. Hundreds of young women from the towns have taken part in the migration, and they have shown a surprising appreciation of the proper nature of farming life. Many of them, when first introduced to the rotational miracles of nature, have shown an understanding and excitement bordering on the emotional. Nearly all of them have enjoyed in some measure the battle with the elements, and nearly all of them have had a consciousness of the importance of the work they were called upon to do, which owed nothing to propaganda about war-time production. Is all this genuine perception of real values, which has occurred in a sense fortuitously but which must be accounted one of the few good results of the war, to be lost in the future, to be driven underground by the smoke, the materialism and the artificiality of town life ? It need not be.

One thing I am sure we have lost through the Industrial Revolution is the wholeness of life. In the days when groups of English people could migrate to a wilderness and sustain themselves in communities where there was not so much as a village store or a local blacksmith, we produced miracles of architecture, literature and, to a less degree, of music and painting. What is more, we produced a population that could appreciate them. This wholeness of life, which might possibly be worth all that we have since achieved, is already largely lost to the towns. But it might be recovered in the country, and there form a source of strength to be drawn on by the towns. But only, however, by men in conjunction with women ; not by men alone, nor yet by women who are their equals but not their partners.

I do not wish to advocate an attempt to revive the virtues of the past by returning to the crafts of the past. I can make no sense of suggestions to turn back a clock that has been set to move only in one direction. But wholeness of life and wholeness of outlook were achieved, and will only be achieved again, through knowledge, and the full and complementary

contribution to that knowledge of men and women. It will not be achieved by women who, living in tasteless and only moderately comfortable houses, bake, sweep, sew, mend and prepare food against the time when the men shall return, with a tolerant and wholly superior affection, to eat it. Nor, for that matter, will it be achieved by women who are unversed in, and unappreciative of, the arts of sewing and baking.

Again, we are all more or less agreed that if agriculture in the future is to meet the demands likely to be made upon it, it must be conducted by business men on scientific principles. But are we agreed to give them a completely free hand in this last and final sanctuary in an industrialized world? Are business men and scientists, who have given us, with apparently equal ease and efficiency, sanitation and slums, housing and jerry-building, main roads and blatant petrol signs, factories and slag heaps, transport and bombs, to be allowed to have their head in the country without any ameliorating influence? This influence might be provided by women of understanding and perception.

The Women's Land Army has brought many young women into contact with real life—life that is close to Nature and therefore basic to our endeavour. What the Land Army has started, such associations as the Young Farmers' Clubs might easily carry on. In the interests of the future of civilization we must hope they will.

WOMEN IN HORTICULTURE

Ruby S. M. Collett, N.D.H. of *Quenchwell, Cornwall,*

and

Katharine Johnstone, M.A., Ph.D.

Ministry of Agriculture and Fisheries

Katharine Johnstone. Now that many women, especially those who are serving in the Women's Land Army, are thinking of the possibility of a career in horticulture, it is thought that readers of *Agriculture* would be interested in the experience of a successful woman horticulturist, such as yourself, Miss Collett.

Ruby Collett. Perhaps I would prefer to say that I have achieved my ambition; I have always wanted to have a farm of my own and to make a success of it. That, I think, is the first and most important consideration—a real desire and the ability to concentrate, plan and work with that aim above all others. Personally, I think it is necessary to have been born and brought up in the country; it is a great advantage to be a farmer's daughter, as I am.

K.J. In other words, to have a real love of the land and a true rural outlook. What steps did you take to achieve your ambition?

R.C. Well, to start with, after a good general education I secured college training, that is, a University course, which I took at Reading. I think one should have some *practical* experience in horticulture first—personally, I did some land work during the last war, although I was then too young to join the W.L.A. Without some practical knowledge one is unable to take full advantage of the theory and science taught at College. Nowadays it would be ideal to take a three-year course, leading to a degree in horticulture.

K.J. And having secured your scientific and theoretical background, what did you do next ?

R.C. My first aim was to qualify for the N.D.H. and to secure practical working experience as an employee, learning how to work and acquiring proficiency in as many branches of horticulture as possible. I chose a variety of jobs and was fortunate to be admitted as a probationer at the Royal Botanic Gardens, Edinburgh, before taking my final examination.

K.J. Thus learning the art and practice of horticulture, one might say. Did you then set about finding a place of your own ?

R.C. No, I took a salaried job first; in those days it was much more difficult to get such a post than it is now, when there are more opportunities and more jobs open to women.

K.J. You were, in fact, a pioneer, being the first woman Horticulture Inspector in the Ministry of Agriculture, and your success pushed the door wide open. But, tell me, why do you regard such a post as important ?

R.C. Well, for one thing, it gives you a sense of responsibility—a real essential for running a farm—I doubt if this sense would usually be developed in a girl of, say, eighteen or twenty; about thirty, I should say, is a good age to shoulder the responsibilities (and they are heavy) of taking a place of your own and looking after a staff.

Secondly, you gain confidence; in an administrative or semi-administrative post you learn how to deal with various types of people, to take decisions and to stand by the results.

Thirdly, it is very useful to get about and see as much as possible of the different aspects of the horticultural industry. When you are working on a horticultural establishment, and still more on your own farm, you are tied down considerably.

K.J. I expect you made some useful contacts too ?

R.C. Yes. Many people were very helpful, both at the outset and afterwards, including county officials and practical growers. I think newcomers to the horticultural industry should realize how important is the help and advice so freely given by horticulturists where they find keenness and willingness to work hard. They should take every advantage of it.

K.J. Having seen so much of horticulture—failures as well as successes, probably—you were not discouraged ?

R.C. Not really; my ambition was still there, but I realized that I might be unlucky and fail, especially since I started during the agricultural depression.

I could also see clearly what I was in for—very hard work, very long hours in all weathers and no prospect of "big money". To me, this was out-weighed by the opportunity to satisfy a deep urge to produce from the land, and by the satisfaction of being my own master and working up something from a small beginning. I always try to make sure that the numerous people who ask my advice really do understand what they will be up against. Flower farming, for example, is not just gathering sheaves of daffodils on the sunny slopes of Mounts Bay, but involves long, hard hours of work at certain seasons, back-wearing hoeing, drenching rain, and probably chilblains—for violet stems are very cold on a winter's morning.

K.J. So far you have talked mostly of your mental preparation; what about the "brass tacks" ?

R.C. Capital is, of course, necessary, and lack of it is often a special handicap to women. I would, however, always advise people to start in a small way and gradually build up—not to throw in all their money to start with, but to feel their way and gradually acquire the equipment that they find they really want.

I think most women prefer a small place—it is more individual and intimate, and although the financial possibilities are modest, the majority of women have no great speculative instinct or special incentive to money-making. When a place gets big you have to expend all your energy managing it; I like growing things myself, and to continue to do this I feel that the holding must be kept to a reasonable size.

My own farm is twelve acres; to begin with, I cultivated six acres and let the remainder for grazing. Now I keep two cows in milk and a couple of pigs—all I can manage in war time—because of the urgent necessity of having some animal manure to keep up the fertility. Cropping is intensive; flowers and strawberries were my main crops in peace time. Since the war I have grown vegetables including outdoor tomatoes, sweet corn and salads.

K.J. What labour do you think is necessary for such a holding as yours?

R.C. I employ two boys and one or two land girls; in peace time additional, temporary labour is needed for seasonal rushes of work—for example, strawberry and flower picking—but this is practically impossible in war time and I have to arrange my cropping to avoid rush periods and according to what labour is available. Several women growers find it useful to employ a man or boy, but a nearby farm of eight acres is run successfully as a market garden staffed entirely by women.

K.J. I notice that your staff remains the same for years. Evidently you are very successful in managing it.

R.C. Proper labour organization is certainly important. It may be a worry, but inability to manage a staff may be a cause of failure—and this applies no less to men than to women.

K.J. I see no sign of your losing interest in your work, but do you think it is possible for that to happen?

R.C. Not to me; the farm is my life, and the thrill of growing and producing things never palls. It may, of course, happen to some people—again to men as well as women—but that would be because they had not the real urge that I mentioned as being so important. I have in fact bought another farm near the sea, and its different conditions and new attractions are of absorbing interest. During the war I have worked the two holdings.

K.J. That is indeed proof of success, undiminished interest and vigour! You yourself have always been very strong physically, but do you think that market-garden work is too hard for the average woman?

R.C. Not if she is reasonably strong and healthy, but it is essential that she should be so. Personally, I do all my own housework as well, but several of my friends work in partnerships, one doing mainly the farmwork and the other the housework. That arrangement answers very well, provided both are really suited temperamentally to such a partnership.

Further, there are now many mechanical implements and appliances which make things easier; the implements are more reliable than they used to be. Also, many women have the necessary mechanical bent for the maintenance of these implements and work them excellently.

K.J. You have trained a number of girls and have had so much experience; what do you think of the general prospects for women in horticulture?

R.C. That is a question that might best be answered by a professional association, particularly the Women's Farm and Garden Association, which, by the way, I would strongly advise all women horticulturists to join.

Openings for women fall into three main groups: the practical workers' jobs, the salaried posts, and the independent market growers.

Practical workers, employed at the statutory agricultural wage, are specially needed for horticultural work requiring deftness, such as propagating and flower bunching. Generally speaking, college training is not needed and such work is liable to be a dead-end, except for trained women, who, starting from the bottom, rise to a good forewoman's job, such as is offered by several of the large horticultural firms, or to responsible positions in domestic and institutional posts carrying salaries up to £250 per annum.

Teaching is a well-known sphere of work and gives great satisfaction to those, and those only, who have a definite flair for it. Salaries run by increments from £200 to a maximum of £420.

Posts under local authorities and the new National Advisory Service are open to women, and horticulturists are glad to know that they will not be considered subservient to agriculturists; salaries are roughly similar to those in the teaching profession. Research also offers opportunities to the scientifically trained, and there are prospects in connexion with landscape gardening and the laying out of parks and open spaces in post-war reconstruction.

Finally, there is the "place of one's own". I have tried to tell of my own experience. There are, of course, other types of holding—everyone grows best the things they like most. Many women make a special success of small nursery gardens and are often particularly successful with alpines; also there are several successful women fruit-growers.

In fact, we come back to the personal urge and ambition. If that is there and is supported by capability for concentrated effort, hard work and perseverance, horticulture has much to offer as a career and a way of life.

GREEN JERSIES

BARBARA WHITTON

(Author of *Green Hands*)

I WAS extremely depressed. It was a cold Saturday night and a persistent rain was falling. I stood on the draughty platform waiting for my train, with my heart in my shoes and my shoes in a good-sized puddle. Mine was the depression that only those who have had to return from leave on the wrong side of a wet week-end will fully appreciate. When eventually my train arrived (late, and then not on the platform I had been led to expect), it was already full. It proved to be one of those poor-relation trains: one that has no corridors, and which is considered too modest and unfashionable to be allowed to appear on a really important journey.

The windows were steamed over, but even through the haze I could see that the compartments were quite full. There was a party of land girls in the last one of all, and, resigning myself to standing for an hour,

I opened the door and got in with them. As I put my case up on the rack the land girls by common consent telescoped to provide a patch of cushioned seat for me. True, the girl on my left had an elbow that did not seem quite to fit in with mine; and the girl on my right was nursing a bunch of dahlias with very wet stalks, but who minded that? Certainly not I! They were a jolly lot with the bright eyes and glowing faces of those who work all day in the open air. We smiled tentatively at each other and I felt my depression lift appreciably. Presently their chatter burst into a popular song; it was cheerful, and we repeated it with much gusto. Then someone started:

We volunteered! (They dragged us in!)
We volunteered! (They dragged us in!)
We volunteered for the Women's Land Army!

I had a slab of chocolate in my pocket which I was unable to reach for myself, but after I had explained the position to the girl with the elbows, she very kindly got it out for me and we shared it amongst us. Some might think that chocolate would have a muting effect on a party of land girls. But this didn't. After a moment of appreciative munching we again burst forth into song.

They got out at the next station and I was sorry to see them go. By this time my depression had completely gone, and I was warm again. There was a woman in one corner of the compartment, a little woman whom I had not really noticed before. Now that we were alone she suddenly swelled like a bird fluffing its feathers and sighed audibly with relief. She looked rather disagreeable, and asked me to open the window to let out the smoke. Then she said:

"*They* seem to thrive on it, I must say!"

The land girls were still standing on the platform chattering gaily in the blue light of the station lamp.

"Yes," I replied. "I think they're wonderful, don't you? It's not an easy life for a girl."

The woman in the corner sniffed meaningly. "No," she responded, "my daughter is in the Waafs," and burying herself behind an evening paper indicated very clearly that as far as she was concerned the conversation was closed.

The train jolted on into the night, and as I looked out into the darkness, I was very angry. I longed to snatch the newspaper from her and to make her realize just what sort of life those girls were going back to that she and her daughter might have their daily bread. So obviously she did not realize. Somebody ought to tell her.

That was a year ago. Even then, had I but known it, Miss V. Sackville West was already engaged in writing a book which would supply just that need—*The Women's Land Army* (Michael Joseph. 5s.)*. No land girl, however exacting, could ask for a better or more sympathetic chronicler.

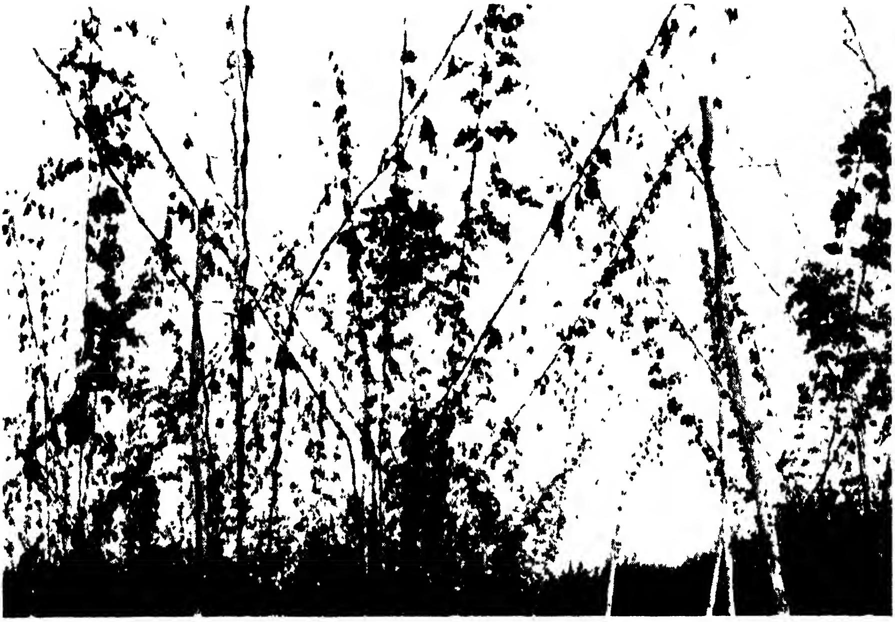
The book itself is fair and appreciative, and at last tells the story of the land girls as it should be told. The land girl herself will like it because it tells her how grand she is—and that is always pleasant! Sometimes when we have been pulling roots on a frosty morning we have wondered if anyone else had any idea just how heroic we really were. Land girls will also enjoy Miss West's book because of its information on all the branches of the Land Army. On our farm *we* were the land army; although there were only two of us nobody dreamed of referring to us as anything else! But for all that, I think we always realized that there *were* other

* All proceeds from this publication are being given to the Women's Land Army Benevolent Fund.

WOMEN ON THE LAND

(Photos 1 4 *Crown Copyright*
(Photo 5 *Sport & General*
(Photo 6 *Keystone*

THREE IMPORTANT HOP DISEASES (See pp. 556-61)



(Photo: W. G. Keyworth

1 Portion of hop garden severely attacked by progressive Wilt

(Photo: W. G. Keyworth

2 Hop plant affected with Nettlehead

(Photo: H. Wormald

3 Mosaic disease on upper portion of bine, showing down-curled leaves and dead tip

land girls—thousands of them, engaged in a variety of jobs, from rat catching to fruit picking and from gardening to land reclamation and forestry.

But more particularly Miss West addresses herself to those outside the ranks of the Land Army. She writes superbly, and is herself so obviously enthusiastic about the country way of life that it is a hardened reader indeed who will fail to be infected. Her book is alive with interest. There is humour in it—for example, the story of the girl who wrote to her Land Army secretary as "Dear Madman" !—and there are flashes of beauty as sudden as the momentary blue of a jay's wing.

> ". . . the orchards heavy with fruit on some gold-dusted morning . . . that strange jewelled world above the ground where the citizens hang coloured and rounded among the flock of leaves . . . As for the lambs . . . how tactful of them to appear just when the fruit blossom fluffs over their heads. They seem made for one another."

Again, when she speaks of felling trees:

> "In past years there was a certain dignity and beauty as well as tragedy, three things well mixed together, in the sight of a great tree being taken away by great horses; they match one another in some suitable natural way; the round strength of the horses was somehow consonant with the rounded majesty of the trunk. The horses were polished and shiny, not rough as was the bark, but there was something of the same quality in both which made the dragging away of the tree less humiliating . . ."

There are stories of heroism, of land girls who risked their lives to save those of their employers—girls who regarded the war with bombs and machine-gun bullets as simply a side-show and their work on the farm as the really important thing. There are human touches, and Miss West shows infinite sympathy and understanding with the girls she writes about. It is obvious that she knows that the bed of the land girl is not all roses.

> "Sometimes she is even frightened . . . She is quite alone. The hedges on either side of the lane are lined with sinister shapes. A twig cracks and she nearly screams . . . She may be frightened of something quite different; of the cow . . . This animal is very large and bony and seems to be provided at every corner with things that can hurt her . . . a kick can be very painful . . . a lash in the eye with a tip of a matted tail can be very painful too."

Elsewhere Miss West speaks with obvious personal knowledge:

> "Take root crops. This is a heavy job and a wet one. Anybody who has walked a field of roots after partridge will know how wet it can be. The top leaves seem to hold water as nothing else holds it, except perhaps a pond. You are drenched to the knees after five minutes. The land girl often spends her day among the roots . . . She is in the bumping seat of the tractor . . . She is cold, and the rain drives in her face; there is no protection on the tractor against the weather. Now she is stooking, and this time the weather is hot; too hot; so hot that she wonders how much longer she can go on; for it is full summer and there is no shade out in the harvest field. She is pitching the heavy sheaves up on to the cart. She is in the stackyard, the threshing machine grinding and clacking . . . the grit and chaff fly all around her, up her nose and down her throat. She is as dirty as a sweep, and the machine proprietor swears at her . . . Or she is out in the snowy forest, her fingers numbed with handling the slippery logs. Or she is up to her ankles in water clearing a ditch. Nobody sees her; nobody but the man whose ordinary life it has always been and who, she knows, will only be too glad of the chance to catch her out."

Poor Cinderella! How true. "A gloomy picture?" asks Miss West. "It might seem so, but the outstanding thing about the land girl is that she isn't gloomy at all. On the contrary, anyone who has seen her about in her few hours off duty must concede that she looks the most cheerful of mortals."

And so she is, bless her. Perhaps if the lady in the corner of the train compartment has read Miss West's book, she may realize that she was a little hasty to condemn.

We volunteered! (They dragged us in!)
We volunteered! (They dragged us in!)
We volunteered for the Women's Land Army!

Whether they volunteered or whether they were "dragged in," the girls in the green jersies are doing a grand job. They ask for no applause, but rather that their efforts, contributing to the winning of the war, may be consummated by a prosperous and abiding peace.

THREE IMPORTANT HOP DISEASES

W. G. KEYWORTH, PH.D.

East Malling Research Station

SOME twenty distinct diseases of hops have been recognized, most of which are infectious and caused by fungi, bacteria or viruses. Five of these are of general concern, and their control is of considerable importance. They are the fungus diseases Mildew (Mould), Downy Mildew and Verticillium Wilt, and the virus diseases Nettlehead and Mosaic. Mildew and Downy Mildew can be adequately treated by routine spraying methods, and their control presents no great difficulty to the grower. Verticillium Wilt, Nettlehead and Mosaic, however, being caused by internal parasites, cannot be treated by such methods. All three diseases have been known for over twenty years, during which time they have become of increasing importance and now constitute a major problem to the industry.

To meet the situation special investigations were started in 1938.* Although there are still many gaps in our knowledge, this work has reached a stage where it is possible to assess the relative significance of each of these diseases and to show what steps must be taken if they are to be dealt with effectively.

VERTICILLIUM WILT

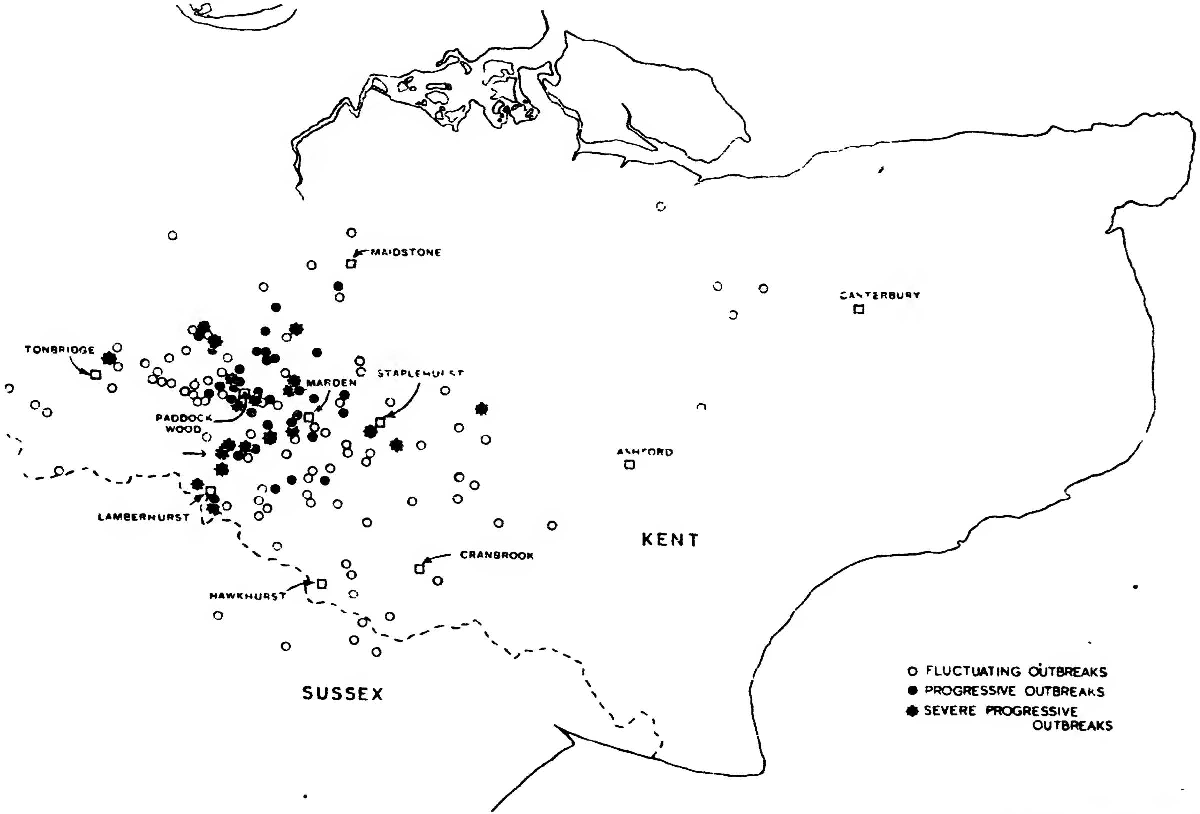
The Fluctuating Type The most striking fact recently discovered is that, contrary to previous ideas, the mild form of this soil disease is very widely distributed. This mild form, known as the Fluctuating Type because of the variation in Wilt intensity from year to year, has been reported from Kent, Sussex, Herefordshire, and Worcestershire. In certification inspections by the Ministry for instance, some growers have learned that their gardens, which they previously believed to be healthy, actually contain well-established outbreaks. In other gardens one or two infected hills only have been seen.

Naturally, growers are disturbed as to the significance of these very widely scattered outbreaks and fear some wholesale attack on the crop. It may be said at once, however, that no such danger exists.

Let us consider the history of this form of the disease. It was first discovered by Mr. R. V. Harris in 1924 in a hop garden at Penshurst,

* Now being undertaken jointly with the Long Ashton Research Station and the South-Eastern Agricultural College, Wye, Kent.

INCIDENCE OF VERTICILLIUM WILT IN SOUTH-EAST ENGLAND



Copyright: *East Malling Research Station*

Kent. Observations in this garden since that time have shown that the total effect on the crop has been almost negligible. True, in some wet seasons, a fair number of bines have wilted and died, but the hills have usually recovered the following season, and the original garden is still in practically full production. In other gardens no wilting has been seen at all. The only visible symptoms in these gardens are coarse, thickened bines on scattered hills, such bines containing the brown wood indicative of the presence of the fungus *Verticillium*. Some of these outbreaks have been traced to previous potato crops—also susceptible to *Verticillium* attack; others have been started by the planting of infected sets; and many are obviously of such long standing that their history is unknown. In fact, it now seems certain that this form of Verticillium Wilt existed in hops long before its discovery in 1924.

The Progressive Type So much for the mild form; but what of the reports of widespread devastation caused by this disease in some areas? Here we are dealing with a really dangerous and quite distinct form of the disease known as the Progressive Type.

The most important feature of this form is that infected hills do not recover and, moreover, as the fungus contaminates the soil, replanting is useless and the affected area becomes derelict. Symptoms appear early in the season and are of a very severe nature. The leaves wilt and die and then fall from the bines, leaving them bare and blackened (Fig. 1, facing p. 555). Starting often from one infected hill, the disease advances through the garden, which may become completely useless in some four or five years. As infection can be spread by the blowing about of the dead leaves, as well as in cultivation, the disease constitutes a danger not only to the one farm but also to others nearby.

The history of outbreaks of this type is particularly significant. The first one to be seen occurred on a farm near Paddock Wood in 1933, having then been in existence for one or two years. In 1934 it was discovered on five other farms in the same neighbourhood. Since that time it has more or less ruined these farms and also spread to some fifty others within a radius of about ten miles.

The map on p. 557 illustrates the present position in the South-east. Both fluctuating and progressive outbreaks are shown, and although our information on their distribution is still incomplete it is clear that the fluctuating outbreaks are spread over a wide area. The progressive outbreaks, on the other hand, are, with one or two exceptions, fairly closely aggregated around the original centre near Paddock Wood.

It is in this at present comparatively limited area that the greatest danger from Verticillium Wilt exists. Here, all growers and their workers should be on the alert for the early signs of the disease. If progressive outbreaks are reported in their very early stages drastic measures will greatly lessen the danger of spread, but if left too long the disease may become uncontrollable.

If outbreaks do occur it is essential that the diseased hills should be removed promptly so as to lessen the danger to neighbouring farms.

What of other districts? Here the use of Wilt-free planting material should solve the problem. If growers will use only cuttings and sets taken from healthy gardens the danger of spread to new areas is very small indeed. Where this precaution is not taken, however, there will always be a danger that new centres of Progressive Wilt will be established, with consequences that may be grave. This precaution applies also to the fluctuating type

of the disease. No matter how innocuous this type may appear at present, it is nevertheless a form of Verticillium Wilt and as such may be related to the progressive type. This point is still being investigated, but meanwhile all growers should avoid planting material from gardens showing even the smallest traces of either form of the disease.

The Ministry's scheme for certifying Wilt-free gardens provides an excellent means to this end. The inspections carried out under this scheme are of a most searching character, and growers can be confident that cuttings from certified gardens constitute the best source of Wilt-free stock at present commercially available.

It is clear that the Progressive Wilt can be kept within bounds and perhaps eventually eradicated, provided strict precautions are taken. The expansion and development of the certification scheme will also help to prevent the further spread of either form of the disease. In addition, research has given a new hope that even the badly affected farms may eventually be brought back into production by the use of resistant varieties. Studies have been made on the Wye Seedling varieties during the past four years, and some five or six of these have proved to be fairly resistant, even under the most severe tests.

THE VIRUS DISEASES

Largely because of the alarming nature of recent outbreaks of Wilt, the dangers of the less spectacular but much more widespread diseases, Nettlehead and Mosaic, have often been neglected. These diseases occur in all hop-growing areas. Nettlehead, although most prevalent in Fuggle, attacks all varieties of hop, but Mosaic only affects Goldings and is thus of greatest importance where these are widely grown, i.e., in Worcestershire and East Kent.

Nettlehead It is not known how long Nettlehead has existed in the hop gardens of this country. First described in 1897, it was undoubtedly present long before that time and has been gradually increasing in importance year by year.

It is an insidious disease. Once infected, the hill becomes permeated with the virus and will never recover, although it may live for several years, gradually declining in vigour and constantly serving as a centre of infection. The intensity of the disease varies greatly with weather conditions. In cool seasons a hill may appear very badly diseased but, as more often happens, if the temperature rises greatly in the summer, the symptoms become "masked" and only reappear with the onset of cooler conditions. This makes efficient roguing very difficult. Some growers start to remove infected hills very early in the season before the bines are trained, and this is undoubtedly the best plan, as such hills can then be picked out by their weak, stiff bines and *up-curled* leaves. Too often, however, this opportunity is missed and the hill is left for grubbing after hop picking or sometimes overlooked completely. A severely affected bine is shown in Fig. 2. Reduction in crop may not be very great in the first year of infection but the cumulative and widespread losses from this disease render it the greatest single cause of loss to the hop industry as a whole.

As with all such troubles prompt action will usually prevent much damage, but the measures taken must be ruthless. In young gardens not only must the obviously infected hills be removed but also those showing only slight symptoms; and as an added precaution in small outbreaks, all hills adjoining those diseased should come out too.

Sometimes, however, the grower is presented with an almost insoluble problem. Like all virus diseases, Nettlehead can be carried in the planting stock. It thus often happens that the grower, when planting a new garden, unsuspectingly scatters the disease throughout it in the sets. The only real cure for such a situation is to take the initial precaution of planting stock of known health. Unfortunately so many growers have now come to regard this disease as a more or less "necessary evil" that not only do they tolerate it in their own gardens but often sell it to others and thus add their quota to the gradual "deterioration" of the stock.

So widespread is this disease that it is becoming difficult to find any gardens completely free from it. In the Ministry's certification scheme, however, a limit of a very low percentage of virus infection has been fixed, and growers who buy certified material will thus be assured of a source of planting stock at least reasonably free from Nettlehead.

There are still big gaps in our knowledge of the disease. It is not known, for instance, how it is transmitted in Nature, although by analogy with similar troubles insects are suspected to be the agents. Again, soil factors, at present obscure, appear to have some relation to the occurrence of the disease. Research has so far failed to show that the virus can actually remain active in the soil and therefore replanting is practicable.

All these points are being investigated. In the meantime, however, growers can do much to help themselves and their neighbours by planting only the healthiest stock and by promptly roguing infected hills when they appear.

Mosaic Mosaic is a lethal disease and thus in some respects presents a more straightforward problem. The first symptom is a curling *downwards* of the leaves, followed by the stopping of growth of the bines and their death backwards from the tips (Fig. 3). The hill becomes rotted and dies in one or two years. Infected hills can thus be fairly readily detected and removed.

One outstanding feature of this disease is the existence of "carriers". Certain varieties of hop can carry the virus within the plant without showing symptoms. The disease can, however, readily spread from such plants to other hops. The most important carrier varieties are Fuggle and the Wye Seedlings. While these hops have the great advantage that they do not succumb to Mosaic themselves, they should always be grown at some distance from Goldings, which otherwise may contract serious and apparently inexplicable outbreaks of Mosaic.

It has recently been found that some male hops also behave in this way, and several outbreaks have been traced to the presence of carrier male plants. Research is now in progress to classify males in this respect and to propagate those suitable for growing with different varieties of hops.

Mosaic virus persists in the cuttings and sets from infected hills, and the remarks made about Nettlehead in this respect apply with equal force to this disease.

Conclusions In order to combat these three diseases certain well-defined lines of action must be followed.

(a) The further spread of all three can be checked by commonsense precautions about planting stock, and everyone is urged to take full advantage of the Ministry's Certification Scheme. Any grower with a really healthy garden can help considerably by entering it for certification.

(b) Growers in the Weald of Kent should always be on the alert for the occurrence of new outbreaks of Verticillium Wilt and report them immediately to the East Malling Research Station; growers elsewhere should make every effort to see that this disease is not introduced into their farms.

(c) Nettlehead demands greater vigilance than has been practised hitherto, both when starting new gardens and when roguing old ones.

(d) Mosaic disease, so great a problem to Golding growers, can be reduced both by roguing and by attention to the proper segregation of varieties.

All these measures demand extra care, but all are eminently practicable, and there is no reason why growers should not in future be increasingly assured of really healthy hop farms.

LEAF SPOT OF CELERY

W. A. R. Dillon Weston, M.A., Ph.D.

School of Agriculture, Cambridge

CELERY Leaf Spot, or Blight as it is sometimes called, is caused by the fungus *Septoria*. Two species are concerned, *S. Apii* and *S. Apii-graveolentis*, but in this country it is the last-named that is the more common and injurious. The chief differences are that with *S. Apii* large brown spots bearing a few spore-cases are formed, whereas with *S. Apii-graveolentis* more numerous but smaller, greenish spots bearing many spore-cases occur.

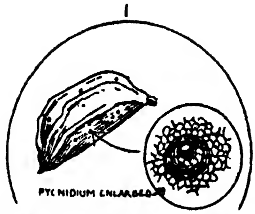
Why is this destructive disease so prevalent? It is because Leaf Spot is seed-borne, and adequate measures are not taken to produce disease-free seed. If infected samples are examined under the microscope minute black spore-cases (*pycnidia*) are seen on the "seed" coat. When such seed is sown these cases release their spores, which infect the young seed leaves. On these, fresh spore-cases form and the disease soon spreads amongst the crowded seedlings. Infection is favoured by moist conditions, and especially by overhead watering and insufficient ventilation. Later, when the seedlings are pricked out into beds, new infections occur. If infected plants are transferred to the field, and if weather conditions favour spread of the disease, serious damage to leaves and seed heads will inevitably result.

Prevalence of Infected Seed Infected seed is all too common in commerce, as the following figures show. During the eleven-year period 1931–42, 557 samples of celery seed were examined at the Official Seed Testing Station, Cambridge, and of these only 64, or just over 10 per cent., were free from infection, while 309 showed up to 20 per cent., 139 from 20–60 per cent., 41 from 60–80 per cent., and 4 over 80 per cent. infection. This is most regrettable, as healthy celery seed can be grown if proper precautions are taken.

Prevention and Control As Leaf Spot results from the sowing of infected seed every effort should be made to obtain clean seed samples, although, admittedly, this is difficult. Growers who do not raise their own disease-free seed should demand healthy seed from their merchants. Failing a guarantee that seed is free from infection, it should be disinfected by steeping it for 3 hours

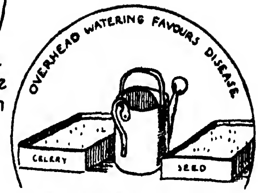
LEAF SPOT OF CELERY

1



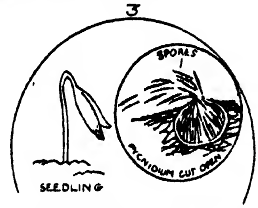
Celery Leaf Spot is a seed-borne disease. On the 'seed' coat are minute cases (pycnidia) which contain the spores causing the disease.

2



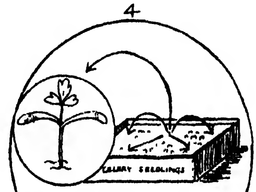
When the seeds are watered the spore-cases start to release their spores..

3



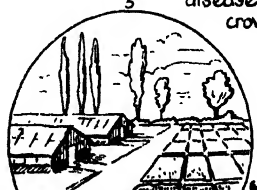
..and these infect the seed-leaves.

4



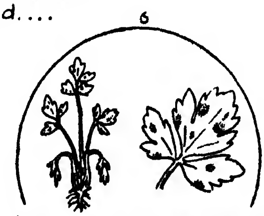
Fresh spore cases form & the disease spreads among the crowded seedlings.

5



Later these are pricked out into beds where fresh infections occur.

6

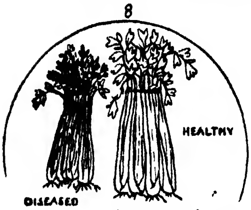


An early stage of the disease. The spots are covered with spore cases

7

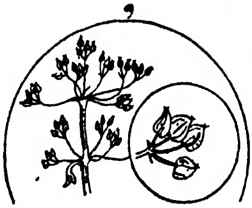
The plants are transferred to the field....

8



.....and a 'blighted' crop results.

9



When plants are grown for seed the disease spreads to the flowers & the seed becomes infected

THE

LIFE CYCLE

OF

Septoria Apii

&

S. Apii-graveolentis

the fungi causing

LEAF SPOT OF CELERY

PREVENTION & CONTROL

Obtain disease-free seed. This can be produced by spraying seed plants regularly with Bordeaux mixture. If healthy seed is unobtainable, disinfect it before sowing, and if disease appears in the crop spray with Bordeaux Mixture.

See Advisory Leaflet 241.

in a solution made up of 1 part of formalin (40 per cent. strength) in 300 parts of water. If the seed is to be kept for any length of time after treatment, care should be taken to see that it is thoroughly dried.

This treatment, though it reduces the disease considerably, does not eliminate it. The real aim should be to get hold of *disease-free* seed. If, in spite of the above-mentioned precautions, the disease appears, either in the seedbeds or in the field, the plants should be sprayed with Bordeaux mixture. In some seasons two or three applications may be sufficient, but in years when moist, unfavourable conditions prevail more will be necessary. For the production of clean seed, regular sprayings with Bordeaux mixture should be given from the seedling stage until the time of seed formation.

ROLE OF THE WETTER IN APPLE SAWFLY CONTROL

G. A. CARTER, B.Sc., A.R.I.C. and C. H. HARDY, B.Sc.

THE use of a wetter in spring and summer sprays is usually recognized as being beneficial, but there are certain exceptions to this rule, and there is the fear that if too much wetter is incorporated in the wash excessive run-off will occur. The need for the inclusion of a wetter is greatest in cases where a contact insecticide is being used, as, for example, to control Apple Sawfly. This insect is responsible for a great deal of the "June Drop" of apples, and is more widespread than many growers realize. It is the object of this article to point out the underlying reasons for the use of a wetter in this connexion, and to discuss the advantages of such use.

The successful control of an insect such as the Apple Sawfly (*Hoplocampa testudinea* Klug) depends upon three major factors: the choice of a suitable insecticide, the correct timing of the application of the spray, and the efficacy with which the wash can be brought into contact with the insect

The choice of an insecticide is governed chiefly by the habits of the insect, and in this instance the choice lies between nicotine and derris. By experiments carried out in 1935, Kearns, Marsh and Martin(1) showed that with correct timing the control obtained by the use of nicotine was better than that given by derris.

It had been shown some years earlier(2) that the correct time for spraying depends upon the date at which the female sawfly lays her eggs, and the state of development of the eggs at the time of spraying. Further experiments, carried out in 1931(3) and 1932(4) confirmed this work, and showed that for the best control the spray should be applied approximately four days before the majority of the eggs would hatch. This date coincides in most seasons with the 80 per cent. Petal Fall stage of Worcester Pearmain, a variety which is very susceptible to Apple Sawfly attack. These observations bore out the earlier work of Petherbridge and Tunnington(5), and subsequently experiments by Moore(6), and Hey and Steer(7) in other districts led to the same conclusions.

Thus two of the three major factors had been decided, leaving the question of the contact of the spray with the insect egg to be examined. This was a point upon which growers lacked precise information, and to some extent this state of affairs has persisted to the present day.

In the literature on the control of Apple Sawfly, differing opinions had been recorded. Some workers, such as Moore(6), Hey and Steer(7), and

Kearns, Marsh and Martin(7), considered the use of a wetter necessary, whereas others, e.g., Steer and Thomas(8), found that the use of a low concentration of wetter did not lead to improved control. Kearns and Marsh(9), however, in 1941, published spray programmes for apples, in which they recommended double the quantity of wetter that had previously been considered sufficient.

Some growers feared that the inclusion of large quantities of wetter in a wash which might contain lime sulphur for Scab control might lead to a reduced Scab control, but Moore and Montgomery(10) showed that this was not the case. Kearns and Marsh(9) and Wallace(11) had referred to the use of Ester Salts Solution as a wetter. (Ester Salts Solution contains as its chief constituent the sodium salts of C_{10}—C_{18} secondary alkyl sulphates.) In view of the differences of opinion referred to above concerning the value of a wetter in Apple Sawfly control, the authors planned experiments to determine the optimum concentration of Ester Salts Solution for this purpose.

The Problem It is necessary at this point to examine the nature of the problem involved. The female sawfly lays her eggs in the calyx of the flower at the base of the stamens, one egg being laid in each blossom attacked. Egg-laying is usually carried out during periods of still, sunny weather, and may extend over a period of some days in some seasons. If a threatened sawfly attack is to be controlled successfully, the egg, and the surrounding calyx tissues, must be wetted by the spray, which, as has been shown above, must contain nicotine in sufficient concentration to control the pest. There is some doubt as to the manner in which the nicotine acts: it may act solely as a contact insecticide on the hatched larvae; it may act partly in this manner and also to some extent as an ovicide on the unhatched egg; or, in addition to the contact insecticide action, the nicotine may to some extent combine with the acids present in the calyx tissue to form salts of nicotine, possibly nicotine malate, thus rendering the calyx tissue poisonous to the larvae. In this latter case the nicotine will be acting partly as a contact poison and partly as a stomach poison. Though the question has not yet been settled conclusively, the evidence available at present suggests that the third explanation is nearest the truth. Very young (first instar) larvae may be found dead after they have penetrated only a short distance into the calyx tissues, although they hatched some time after the spray had been applied, and it is reasonable to argue from this that these larvae must have eaten a stomach poison which could only have resulted from the "fixing" of some of the nicotine in the manner suggested above.

Importance of the Advancing Contact Angle Whatever the final explanation of the facts may be, it is evident that the penetration of the spray to the bottom of the calyx cup is essential if good control of the sawfly attack is to be obtained. Since it is impossible to direct the spray into each individual blossom to ensure this penetration, it is necessary to add a wetter to the spray so that, unaided by the force of the spray jet, it can still creep into the calyx. To do this, the spray must pass down the tube formed by the stamens of the flower, and since this tube is narrow and waxy-surfaced, this will only occur if the advancing contact angle of the spray fluid is reduced to as low a figure as possible. This advancing contact angle is the angle formed by the surface of the liquid and the surface of the material being wetted by the liquid during the period while the liquid is spreading out over the

material. The lower the advancing contact angle the more easily does the liquid spread and wet the material, and it is only by the addition of a wetter that the advancing contact angle of water on the waxy surface of the stamen tissue can be lowered sufficiently to enable spontaneous penetration of the stamen tube.

The importance of the advancing contact angle measurement as an index of the efficacy of a wetter was pointed out by Evans and Martin[12] in the course of their studies of wetting and spreading phenomena, and it can be deduced from a study of the physical problem involved that the maximum penetration of the stamen tube, and hence the realizing of the maximum efficiency of a nicotine wash for Apple Sawfly control, will be achieved when the concentration of wetter in the spray is such that the advancing contact angle of the spray fluid on the stamen tube tissue has been reduced to the lowest practical value. Since the slope of the advancing contact angle/concentration curve is steep at low concentrations, there will be for each wetter a critical concentration, below which wide variations in the efficiency of the spray may be observed in comparable circumstances.

Experiment with Ester Salts Solution To confirm by field experiment the soundness of the above reasoning, and at the same time to determine in practical conditions the correct concentration at which Ester Salts Solution should be used with nicotine for Apple Sawfly control, the following experiment was planned. An orchard consisting chiefly of Worcester Pearmain and known to be attacked regularly by the insect, was divided into twelve comparable plots. Three plots were left unsprayed, to act as control plots for determining the level of attack, while on the remaining nine plots three different treatments were applied, so that there were three replicates of each treatment. The blocks were randomized, to avoid, as far as possible, chance variations in the severity of the attack. The treatments were as follows:

Treatment 1. Nicotine 0.05 per cent. Ester Salts Solution 0.0625 per cent.
Treatment 2. Nicotine 0.05 per cent. Ester Salts Solution 0.125 per cent.
Treatment 3. Nicotine 0.05 per cent. Ester Salts Solution 0.1875 per cent.

These treatments correspond to the use of 8 oz. of nicotine per hundred gallons of wash (the concentration known to be effective in practice), together with 10, 20 and 30 fl. oz. respectively of Ester Salts Solution.

The washes were applied on May 11, 1943, the date of 80 per cent. Petal Fall of Worcester Pearmain in that season.

Counts of the fruits which had been attacked by sawfly were made extending over the period June to August, to determine the relative control given by each treatment. Approximately 9,000 fruits were examined for sawfly attack in each replicate block, and the percentage of attack was calculated. The data obtained were as follows:

TREATMENT	PERCENTAGE ATTACK	DEGREES
	27.55	31.66
Control (no spray)	18.80	25.70
	6.37	14.62
	6.08	14.28
Treatment 1	9.21	17.67
	0 93	5.53
	2.10	8.35
Treatment 2	4.56	12.33
	1.07	5.94
	6.15	14.36
Treatment 3	2.75	9.54
	0.87	5.35

Since the attack was of a low order, the percentage attack figures were transformed to degrees of an angle, using C. I. Bliss's Tables of Angular Transformation, as given in Leonard and Clark's *Field Plot Technique*, the resulting figures being used for the statistical analysis. This analysis showed that all treatments were significantly better than the controls, and that Treatments 2 and 3 were of equal efficacy, both being significantly better than Treatment 1.

Discussion The data quoted above confirm that as was expected from the theoretical considerations, the addition of a wetter to a nicotine wash improves the control of Apple Sawfly. They also demonstrate that there is a concentration of wetter beyond which no further improvement in control is to be obtained, and that in the case of the wetter employed in these experiments, this concentration is 0.125 per cent., or 1 pint per hundred gallons of spray.

The results are in agreement with those given in the references 1, 6, 7 and 10, and show that there is full experimental evidence to support the recommendations quoted in reference 9. It is hoped that this article will clarify the position regarding the correct use of a wetter in the sawfly spray.

Acknowledgments The authors, the first of whom carried out the field trial referred to above, wish to thank K. Bomfort, Esq., of Harvington, Worcs., for the valuable assistance he gave with the field trial. Their thanks are also due to S. C. Pearce, Esq., of East Malling Research Station, for his guidance in connexion with the statistical treatment of the results of the field trial, and to Messrs. Technical Products, Limited, for the facilities afforded by them in the course of the work.

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AGRICULTURE - INDEX

The Index to Vol. LI will be issued with the April, **1945**, *number.*

TREES AND COMPOSTS

M. C. Rayner, D. Sc.

Dr. Rayner is a botanist well-known for her researches on mycorrhizal association in plants, and the author of the standard work in English on this subject. Since 1933 this specialist knowledge has been applied to intensive researches into the causes of defective tree growth on the area now known as Wareham Forest, and elsewhere. Below is given a brief account of the Wareham experiments; the nature of the problem in this area, and the researches that led to the successful use of compost treatments to re-establish soil fertility. A short review of her recent book, *Problems in Tree Nutrition*, written in collaboration with Professor W. Neilson-Jones, has been contributed on p. 576 by G. V. Jacks of the Imperial Bureau of Soil Science, Rothamsted.

WAREHAM FOREST forms part of the great expanse of singularly barren heathlands in south-east Dorset and will be familiar to readers of Thomas Hardy's Wessex novels as Egdon Heath. The area was acquired by the Forestry Commission in 1923, and has been notoriously infertile from the earliest records. This state of infertility has possibly been aggravated by the extensive stripping of the surface peat which has occurred during the last hundred years. The soil is underlain by tertiary beds of sand, gravel and other estuarine deposits, varying in elevation up to 250 feet.

The natural vegetation is mainly *Calluna*, with other heather species all of poor quality, and a very small number of other plant species. Areas of similar geological origin on Bagshot Beds in Surrey and elsewhere carry a much more vigorous vegetation of similar type, and show rapid regeneration and active growth of native Scots pine and birch. With the exception of a rare, dwarfed and distorted Scots pine and a few small mixed copses on the wetter parts, Wareham Heath was treeless; neither Scots pine nor birch could successfully be raised from seed in the untreated soil, and plantings of various species of pine gave irregular and unsatisfactory results, with a tendency for the young trees to go sporadically into " check " for indefinite periods. Deep ploughing improved the soil conditions, although puzzling inconsistencies of growth and inhibition of root and mycorrhizal development persisted.

Absence of Biological Activity in the Soil Observations in field and laboratory pointed to the existence of soil toxicity, general throughout the area, often localized and curiously confined within narrow limits, causing maximum depression of growth in early spring, and reduced to a minimum after a dry summer. The presence of such specific toxicity was established in subsequent researches. Doubtless the ultimate cause is mainly defective aeration due to waterlogging, the immediate effects on root activity and growth depending on profound disturbance and lack of equilibrium in the biological soil activities. The origin and nature of this disturbance has been discussed elsewhere.

A notable feature of the soil inertia so brought about is the almost complete inhibition of fungus activity, leading directly to the arrest of normal root growth and mycorrhizal activity in seedlings and young plants of pine and other trees. Inertia in respect of biological activities in soils of this type is, of course, well recognized; the technique now devised for analysis of the exact nature of its origin and of its immediate effects on tree growth was novel, and proved singularly effective in demonstrating the character of the causes at work.

At an early stage of the investigation, it was realized that healthy growth of the trees was bound up with re-activation of the soil—with conversion of micro-biological activity from a static or inert to a dynamic or

active condition. The use of organic composts made from straw, sawdust, spent hops and various waste products was directed to this end by inducing such changes in the soil humus as would favour the growth of a specific group of soil fungi: it was, in fact, an attempt at biological control.

Compost Treatments The effect of compost treatments on growth was immediate and dramatic. It is manifested as: (a) improved growth of the trees, often spectacular in degree, without disturbance of the root/shoot growth ratio; (b) removal of inhibition of fungal growth and mycorrhizal activity, followed by the appearance of toadstools or fruit bodies of the mycorrhiza-forming fungi on all treated areas and the rapid breakdown of surface litter. The changes appear to be self-propagating, the effect upon growth persisting for many years after application of the composts. As judged by evidence derived from the rate of cellulose decomposition and breakdown of organic matter in general, from the activity of fungus growth and the development of fungus-roots or mycorrhizas, and from the spontaneous appearance of increased numbers of soil fungi known to be responsible for the formation of fungus-roots; in all these ways, conversion of a soil condition of inertia—perhaps better described as suspended animation—to one of biological activity, appears to be complete.

All the composts used contained available nutrients, some of them appreciable amounts of, for example, phosphates. For reasons that have been fully discussed elsewhere, the poverty of Wareham soil in mineral nutrients was not, and is not now, regarded as critical for healthy tree growth, except in respect to phosphate deficiency, which appeared to act as a limiting factor, and is now known to do so. It is believed that the striking effects brought about by the addition of composts to natural soils such as those at Wareham Forest and elsewhere, and to various nursery soils showing reduced fertility, their uniformity, magnitude, and persistence, are bound up with changes in the humus constituents and the biological activities related thereto, and do not depend primarily, or to any great extent, on the addition of mineral nutrients contained in the composts. There are reasons for believing that the observed stimulus to growth, especially in respect to root activity, that follows direct application of phosphate in certain forms may also be indirect in character.

Re-activation of Soil The Wareham experiments have attracted attention and have aroused considerable interest; partly, no doubt, because of spectacular effects on growth in a soil notoriously poor in nutrients, but also because the interpretation placed on the results, dictated by mycological rather than chemical considerations, is in disagreement with that likely to be held by a majority of soil chemists. That this should be so is not surprising in view of the stereotyped attitude adopted in botanical text-books and curricula towards the part played by mycorrhizal phenomena in plant life and nutrition, and the almost complete neglect of this aspect of soil biology by soil investigators and plant pathologists.

Whatever conclusions are deduced from the action of composts in the Wareham experiments, and whatever interpretation may be placed upon them, it should be clearly understood that the original use of composts in these forestry researches was in no way related to the controversy now raging regarding the use or abuse of inorganic fertilizers as compared with composts. Their employment was prompted by entirely different considerations; not as manurial treatments to make good known deficiencies in available plant food for the trees, but as a means of re-activating a soil mechanism out of gear; a mechanism bound up with the normal nutrition of the trees

n soils of this type and with the maintenance of soil fertility in natural woodlands, in which fungal activity plays a predominant part. That the presence of significant amounts of available nutrients, especially phosphates, in certain composts—for example those made from spent hops—plays a distinct and supplementary part in the growth reactions observed was, of course, noted and placed on record.

In their own way the Wareham experiments provide striking confirmation of the fact that pines and other trees forming root associations with fungi supplement the kind of nutrition common to all green plants by that characteristic of fungi. The benefits that follow compost application demonstrate that successful culture of such plants can best be ensured by treatments providing optimum conditions for the soil fungi concerned.

The relevance of the conclusions expressed in this note to problems presented by cultivated soils, and the part played under such conditions by those mycorrhizal associations of a different type present in so many agricultural crop plants, requires investigation.

CAN AGRICULTURE SERVE THE CHEMICAL INDUSTRY ?

E. F. Armstrong, F.R.S.

President, Royal Society of Arts

THERE is, I think, a great future for agriculture to supply raw materials —sometimes called chemurgical materials—for the use of the chemical industry. By the sweat of his brow and the aid of the sun and the rain, man produces from the soil foodstuffs for himself and his animals. The process is, however, frequently marked by some waste for, apart from seasonal variations in the quantity and quality of the harvest, when it comes to selling the crop too much normally depends on a variable market and unstable prices. In consequence, much that is grown is left to decompose into simple products which return to the soil and the air.

Agriculture badly needs another and more regular outlet for its products, such as would be provided if they became raw materials for new chemical industries. With good organization and cheap transport, such as the motor lorry, available from every field, it should be possible to translate far more of what is grown into alcohol, protein or fat, and so lessen the waste. If such an ideal can be realized great new industries based on the supply of indigenous materials could be set up in this country, and every yard of ground would be turned to account.

The idea has been clearly put by Mr. G. A. Sloan, President of the Nutrition Foundation in the United States, who says : "We think of cattle, corn, peanuts and soya bean primarily as food. In future we will think of them also as sources of penicillin, synthetic fibres, hormones, vitamins, plastics and a host of new products which will increase the return to the farmers who raise them."

In this article it is proposed to examine some aspects of the problem primarily from the chemical point of view. In doing so it must be emphasized that the economic aspect has not been disregarded, in particular the cost of collecting field products, which depends on a plentiful supply of labour at an economic cost. The common nettle, for example, has many uses :

among others, as a first-class fibre and a source of chlorophyll. But its collection from waste places in small quantities is too costly, and its growth as a field crop would undoubtedly be frowned on as likely to propagate the spread of a greedy weed. Nevertheless it is found possible to collect and make use of nettles on the Continent. Varieties which give improved yields of fibre of flax quality have been developed.

It should, however, be possible to cultivate herbs and medicinal plants on a much larger scale as sources of substances for the fine chemical and drug industry. A system of five-year contracts at fixed prices would encourage growers otherwise unwilling to face the somewhat rapid fluctuations of world prices of these materials.

Industrial Alcohol from Farm Crops If Britain is to enter the market for plastics on a large scale, the outstanding need will be for industrial alcohol, produced by the fermentation of any carbohydrate material, both primary and waste. Here the farm can surely help. Simple fermentation factories could be set up locally to serve a radius of 100 miles, or whatever the distance of the economic haul may be. To these would come both crops specially grown for the purpose and spoiled cereals, potatoes and surplus greenstuff. A new and simple technique for dealing with these at the plant would be necessary, but this should not be a difficult problem for the research worker to solve. Admittedly the factory might compete with the farm needs for stock and poultry feed, but there should be enough for both, and the farmer must evolve a balanced division between the two calls. At least the excess would be used and not wasted.

The production of sugar by plants is definitely a function of the sun's light and heat, in both of which this country is not too well placed, but by careful selection of suitable strains we can do much better than in the past when we have been largely content with growing cereals and roots.

Scientific breeding and selection is as yet only in its infancy in this country; it can work wonders in farm crops, vegetables and fruit, as well as in animals. Plant and animal breeders must be given every encouragement to get to work on broad lines so as to produce *quality* as well as quantity, and eventually to aim also at a high sugar, high fat or high protein content, or even high drug percentage, as well as to persist on the present lines of producing species resistant to disease.

It is gradually being realized that industrial alcohol is a raw material of enormous potential importance. Alcohol has long been used as a solvent or to make other industrial solvents. Before the war it was coming into use as power alcohol and now, as a two-carbon compound, it is the basis of the new chemical synthesis of useful substances containing a thousand and more carbons arranged in very long chains to which the group name of "plastics" has been given.

Perhaps as much as half of the million tons of synthetic rubber which is being made in America originates from grain alcohol.

Some say we have not room to grow carbohydrates for alcohol in this country, since we have only 1¼ acres per head of population. But at least we can avoid much waste; the most casual visit to the country discloses some land which is not under cultivation and indeed is producing weeds—a striking contrast to normal conditions on the Continent.

Straw for Plastics Another farm product is cereal straw. During the war a large amount has been used for paper, and a certain quantity for cellulose. Neither use has given complete satisfaction and no doubt more practical research work is necessary. Another straw

component is ligno-cellulose, used in the plastics industry. It is clear that the best possible use should be made of straw in regard to its chemical ingredients. Some will be required as fodder and litter and for packing china, glass, etc., but in any case it must be wrong to burn it.

Wood Sugar and Food Yeast It is doubtful whether timber is going to be available either in quantity or so easily as before the war. The demand both for newsprint and for cellulose to make textiles will increase, so that renewed attention will have to be given to other sources of supply. Among such it may well be that twigs and small wood pieces hitherto almost entirely wasted will come under consideration. Both the Bergius and Scholler processes of making wood sugar have now been worked out on an industrial scale; the latter, which uses sulphuric acid, should appeal in Britain, where we have such a large capacity for making this acid. Wood sugar can be fermented to make food yeast, another chemurgical industry, which may prove an important source of making edible protein, being perhaps quicker, cheaper and requiring less land than the present method of feeding stock. The war has given us a rude jolt in regard to the economics of feeding pigs, poultry and cattle. Of all animal foodstuffs, milk is the most economic to produce when there is a scarcity of feedingstuffs, and future world conditions may force us to consider the place of food yeast and of protein from soya or native seeds and nuts in the competitive scale.

There is space here to mention only one other farm product—oat hulls or husks, from which a chemical called furfural can be obtained. This is a unit ingredient of a group of plastics, and it has other commercial uses. It has long been made in quantity across the Atlantic, and it is understood that recently a factory to make it has been brought into production in Scotland.

Synthetic Silk and Wool from Vegetable Oils For our clothing we require both animal and vegetable fibres composed of protein and cellulose respectively. The former are two in number: silk from the silkworm and wool from the sheep—each with very different properties. The chemist has made a substitute for silk, called nylon, which will largely replace it, and is hot on the trail of making a substitute protein wool using an agricultural product as his starting point. To-day the sheep turns grass and roots into wool by processes of which we know little, whilst the chemist shortens the circuit by turning vegetable protein into wool. The chemists of one leading chemical firm took peanut or groundnut protein as their starting point. This is an Empire product, and a warmer climate than we possess is required to grow the nuts. But in all probability the way is open and the clues have been discovered to make a similar wool-like product from soya bean protein or from the protein of nuts or seeds already native to this country: this is yet another reason for making a serious attempt to grow soya bean in Britain. It is known that there are many hundreds of types and strains and that the bean is peculiarly sensitive to changes in soil and climate, so that intensive study is required under local conditions to produce strains giving yield and quality. When successful, soya bean culture should be highly remunerative, for the oil is valuable both for edible oil and soap, the meal is a stock food, and the protein is a human food and perhaps a source of "near" wool also.

If our acres are few in number, that is all the more reason to grow "quality," high-value crops on them.

LIME SPREADING MACHINERY

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THERE are so many different forms of lime used for agricultural purposes that to date it has not been possible to evolve a machine that will deal satisfactorily with all of them. Different kinds of lime include the dry, free-running, finely ground limestone and ground burnt lime, "lump" lime, which requires very even slaking before it can be spread efficiently by mechanical means, and lime sludge, which on delivery from the factory may contain more than half its weight as water.

Most artificial manure spreaders, with slight modifications, can be used to apply free-running finely ground lime and ground limestone at rates up to 25–30 cwt. per acre. The great drawback to using this type of machine for applying such heavy dressings is the inadequate hopper capacity, which necessitates frequent refilling.

Various forms of centrifugal spreaders have been used with some success for spreading the coarser grades of lime, limestone and ground chalk. An inherent difficulty with this type of machine is that the heavier particles are thrown to the extremities of the "spread," giving a false impression of the width of "spread". Particular care must therefore be taken to ensure successful "joins". The lime is shovelled from the trailer or cart, either directly on to the disc or into a hopper above the disc. With a substitute protein wool, using an agricultural product as his starting the former the evenness of spreading depends on rhythmic shovelling, and in the latter an adequate agitation of the lime in the hopper.

Attempts have been made in other machines to transfer the material from the hopper into the spreading mechanism mechanically. This is usually effected by constructing the floor of the hopper as an endless conveyor. Where the hopper is mounted on a lorry chassis, the haulier is also the spreading agent, the material being carted straight on to the field and spread without further handling.

FARMING NOTES

Rearing the Orphan Foal The orphan animal on a farm is always a problem, but in no instance is it greater than with the motherless foal. Obviously mare's milk is the food *par excellence*, but when, as generally occurs, a foster-mare is not available, recourse must be had to hand rearing on cow's milk. Immediately, however, one runs up against the difference in composition between the natural and artificial diets. The growth-rate of a calf is higher than that of a foal, and hence the protein content of cow's milk is higher; on the other hand, the foal's need for sugar is greater and its fat requirement is lower. The comparison below shows the variation between the two classes of milk:

	Water *per cent.*	Protein *per cent.*	Sugar *per cent.*	Fat *per cent.*	Mineral Matter *per cent.*
Cow	87.2	3.5	4.9	3.7	0.7
Mare	89.0	2.7	6.2	1.6	0.6

Thus it is a question of approximating the foal's natural food as closely as possible.

First, dissolve a tablespoonful of sugar (preferably milk sugar or lactose, or failing that, glucose) in a little warm water. To this, add three or four

tablespoonfuls of lime water to correct the mineral deficiency, and then make up to one pint with fresh milk, preferably of low fat content.

The mixture is best fed from a bottle with a large teat—and always at blood heat. For the first few days give ¼ pint (5 fl. oz.) every hour. As growth proceeds gradually increase the amount of milk and the length of time between feeds, until after about a week six feeds a day are being given, and later only four. At three to four weeks old the sugar can be discontinued and the foal put out to nibble fresh, clean grass. At six weeks the whole milk can be substituted by skim milk, and at about two months old, give a little solid food—say, bran and crushed oats.

By this time the foal should be on the bucket. Any tendency to scouring should be dealt with by administering 2–3 tablespoonfuls of castor oil, and substituting sweetened water and lime water for the milk over two or three meals. When the milk diet is finally discontinued it is a good plan to include a small quantity of cod-liver oil in the feed.

Crystal Violet Vaccine against Swine Fever Experiments with crystal violet vaccine to ascertain its possibilities for the immunization of pigs against swine fever were reported upon last autumn. The general conclusion to be drawn from the report was that if this vaccine could be used under suitable conditions it should prove a valuable method for controlling the disease and reducing the losses caused by swine fever.

The principal practical difficulties to be overcome before this vaccine can be put into general use are those of supply and price. So far, crystal violet vaccine has to be imported from America, and the supply is very short. Moreover, the cost of the vaccine and of treatment would at present make its use uneconomic for most pig producers.

The possibilities of producing this vaccine in suitable quantities in this country are under examination by the Ministry of Agriculture; but even if it is found practicable to arrange for production, and at a suitable price, some considerable time must inevitably elapse before supplies can be made generally available.

The results of the experiments already conducted in this country can hardly be of more than academic interest to pig producers generally unless and until supplies of the vaccine become more readily available, and in these circumstances the Ministry has refrained from giving the matter wide publicity. If, however, it is found possible to arrange for larger supplies, a further announcement on the subject will be made at a suitable time.

Woolly Aphis Control by Parasite So far the customary method of keeping woolly aphis in check in established orchards has been winter spraying with tar or mineral oil washes and summer spraying with a contact insecticide. But neither can always be relied upon to give an effective control. Recent experience, however, with a parasite of this insect, *Aphelinus mali* Hald, suggests hopeful possibilities.

It was about 25 years ago that Mr. R. J. Tilyard began experiments with this parasite in New Zealand, and they proved so effective that the pest was cleared up. In 1924 the parasites were released in Kent, and they completely cleared their host from an orchard in Scadbury Park, Chislehurst, which had become so badly infested that picking had been discontinued. But in spite of this and other successes, there was no evidence that *Aphelinus mali* had established itself under our conditions. By 1939 colonies of woolly aphis were re-establishing themselves where they had been extirpated,

and there was no sign of the parasite. The experiment was abandoned as just another of those disappointments with which scientists are only too familiar.

But in 1942 information received from the Chelmsford district showed that the parasite had made another appearance and was rapidly colonizing over a wide area where it had been liberated a few years earlier. Its progress was still more rapid in 1943, and so a fresh survey was made which proved most interesting. At Paddock Wood, in Kent, control of the aphis by the parasite was complete, and the parasite was migrating to other infested orchards. Since then it has parasitized woolly aphis-infested areas in Essex, West Sussex and Kent with almost one hundred per cent. efficiency.

An explanation of the sudden reappearance of the parasite in large numbers in 1943 is suggested by Dr. A. M. Massee of East Malling Research Station, to whom is due the credit for this work in England. Although *Aphelinus mali* can withstand very low temperatures (it thrives in some of the warmer parts of Russia), the damp English climate is not suitable to it. The last three years in southern and eastern England, however, have been abnormally dry, and it may be that the parasite survived in small numbers that were undetected. With more congenial climatic conditions this small nucleus has multiplied.

Experiments last season showed that the parasite can be kept in cold store successfully at a temperature of 37° F., but those kept in dry store failed to emerge. It seems probable, therefore, that fruit-growers will shortly have a most valuable ally in sufficient numbers to remove the woolly aphis menace from their orchards.

Earthworms and Soil Fertility One acre of agricultural land may, according to type, contain anything from 7 to 15 cwt. of invertebrates, with earthworms predominating. It is known that worm casts are often richer in nitrogen, phosphorus and potash than the surrounding soil, but this may be due to the selective feeding instinct of worms, which merely brings about a change in distribution of plant food contained in the soil.

There are 36 species of earthworms in the United Kingdom, but only a few are really common in agricultural land.

There are few reliable data to indicate the effect of worms on soil fertility, and it is to supply this information upon which larger experiments can be based, that the Entomological Laboratory at Rothamsted Experimental Station has recently started a series of pot experiments.

A number of pots have been filled with poor soil known to be deficient in nitrogen. These pots have been divided into three main sections, the first containing no worms, the second living worms of a known weight, and the third dead worms of the same weight. The soil in the pots in each of the three sections has been subjected to three different treatments: (1) no farmyard manure, (2) 25 grammes of farmyard manure, (3) 50 grammes of farmyard manure. An ingenious wire trap prevents the escape of any worm that may feel in need of a complete change.

When sufficient time has elapsed for the farmyard manure to have been used up, the living worms will be removed and all pots will be sown with a crop of mustard or spinach beet, for these are nitrogen-hungry plants, and it is chiefly the nitrogen question that is being investigated. Differences in the resulting crops will be noted. If thought necessary both the plants and the soil will be analysed for their nitrogen content.

Farmers' Guide to the Sale of Corn A revised, up-to-date edition of this booklet (first issued in December, 1942) is now available. It summarizes the provisions and purposes of the relevant Orders in force on December 1, 1944, and also explains the arrangements made for the production, marketing and use of corn crops. A short section on grain drying is included.

The publication may be obtained free of charge on application to the Ministry of Agriculture, Africa House, Kingsway, London, W.C.1.

THE MINISTRY'S PUBLICATIONS

Since the date of the list published in the December issue of this JOURNAL (p. 429), the undermentioned publications have been issued :

Bulletins Copies are obtainable at the price mentioned from the Sales Offices of H.M. Stationery Office or through any bookseller.
No. 113 Rhubarb (*New*). 9d. net (10d. by post).
No. 121 The Cultivation of Medicinal Plants (*Revised*). 6d net (7d. by post).
No. 123 Diseases of Vegetables (*Revised*). 1s. 6d. net (1s. 8d. by post).

Advisory Leaflets Single copies of not more than 16 leaflets may be obtained, free of charge, on application to the Ministry, Berri Court Hotel, St. Annes, Lytham St. Annes, Lancs. Copies beyond this limit must be purchased from the Sales Offices of H.M. Stationery Office, price 1d. each net (2d. by post), or 9d. net per doz. (11d. by post).
No. 139 Virus Diseases of Potatoes (*Rewritten*).
No. 274 Wart Disease of Potatoes (*Revised*).

"Growmore" Leaflets Single copies of these leaflets may be obtained free on application to the Ministry only (copies are not obtainable from H.M. Stationery Office). The following further issue is now available :
No. 43 Straw for Fodder (*Revised*).

AGRICULTURAL INDEX NUMBER

MONTHLY INDEX NUMBERS OF PRICES OF AGRICULTURAL PRODUCTS INCLUDING GOVERNMENT GRANTS. (BASE 1927–29 = 100)

Month	Uncorrected for Seasonal Variation					*Corrected for Seasonal Variation*				
	1939	1941	1942	1943	1944	*1939*	*1941*	*1942*	*1943*	*1944*
January	95	149	176	182	191†	*89*	*137*	*162*	*167*	*173†*
February	94	144	179	180	188†	*88*	*135*	*168*	*168*	*173†*
March	91	143	177	174	182†	*91*	*144*	*179*	*173*	*178†*
April	90	138	162	158	164†	*95*	*145*	*172*	*166*	*171†*
May	82	130	155	150	152†	*91*	*147*	*175*	*168*	*171†*
June	80	129	153	149	150†	*89*	*145*	*172*	*166*	*170†*
July	85	137	155	153†	156†	*93*	*148*	*168*	*165†*	*169†*
August	86	140	152	152†	156†	*91*	*147*	*159*	*161†*	*173†*
September	92	140	148	148†	152†	*93*	*143*	*151*	*152†*	*157†*
October	96	155	165	164†	171†	*92*	*148*	*157*	*157†*	*164†*
November	106	163	175	174†	184†	*98*	*150*	*162*	*161†*	*169†*
December	113	169	180	183†	189†	*103*	*153*	*163*	*166†*	*171†*

† Provisional

This Table incorporates certain revisions, the chief of which is the calculation of the allowances made in respect of the acreage payments on potatoes (from July, 1941) and wheat (from August, 1943). In computing the index numbers for these products, allowances are now based on the estimated quantities entering into sale and not, as formerly, on the estimated total production of each of the respective crops. Revisions of other indices have been referred to in previous issues of this JOURNAL.

NOTICES OF BOOKS

Problems in Tree Nutrition. M. C. RAYNER and W. NEILSON-JONES. Faber and Faber. 12*s.* 6*d.*

The Bagshot sands of East Dorset are extremely poor in plant food, and a considerable area was acquired for afforestation by the Forestry Commission in 1923 and succeeding years. Pines grew well on other parts of the Bagshot sands but seedlings did badly in the Wareham region. There was no sign of root disease or parasitic attack by soil micro-organisms. Ploughing brought about some improvement indicating defective aeration as one of the causes, but it did not solve the difficulty, nor did manuring. Knowing that pine roots need the association of a particular fungus to make a mycorrhiza, Dr. Rayner introduced some of this with very beneficial results. Even then, however, growth was not entirely satisfactory, and she was led to the conclusion that some toxic substance, either present or being produced in the soil, was hindering the proper functioning of the root-fungus association. Bacteria capable of producing hydrogen sulphide from sulphates or sulphur contained in organic matter having been found in the soil, it was assumed that this might be the toxin, though neither it nor sulphates were found in the soil. But the addition of a compost made by rotting straw, spent hops, mixtures of sawdust and other vegetable wastes, entirely overcame the trouble and enabled the young pine seedlings to make satisfactory growth.

Dr. Rayner's explanation is that in the natural soil the proper fungus could not maintain itself, but was liable to be replaced by a psuedo-mycorrhiza of little or no advantage of the seedling. Only after the addition of the compost had supplied the suitable type of organic matter, could the beneficial fungus continue to act. Cellulose decomposition was hastened considerably, and no doubt other changes were also brought about.

An account of the work is set out clearly and at length, and furnishes the forester with much useful background knowledge about the relations of soil and tree. Its practical applications are obvious and will no doubt be tested, but the chief immediate need is examination of the whole subject by a competent soil chemist.

Incidentally P. E. Müller, the distinguished Danish forester, p. 177 as a German, was born in Copenhagen in 1840, the son of a and has worked all his life on Danish forestry and agriculture.

Agriculture : A Digest of Fifteen Reports on Agricul Reconstruction. (Staples Reconstruction Digests : What Peo King and Staples. 2*s.*

Many policies for the future of agriculture have been put forv two or three years, and this booklet fulfils a useful purpose in sc convenient for reference and comparison the main recommendatio reports on post-war agricultural policy. The material is classified un and consists mainly of verbatim extracts from the reports. The representative of the main political parties and agricultural org include two official reports on rural housing and water supply. T full text of the combined statement adopted at a conference of number of bodies convened by the Royal Agricultural Society appendix outlines the provisions of the Agriculture (Miscellaneous Provisions) Act, 1944.

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